

IMPROVISING SCIENCE TEACHING KITS FOR SCHOOLS

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Foreword

OURS is a poor country with extremely limited resources for school education. In the context of modern developments, the teaching of science at all levels of school education is a must. It is through science that we can find a proper cure for obscurantism, superstition and other wild beliefs. The children of today will be the citizens of tomorrow. They have to be shaped to become amenable to reason and prevented from being carried away by emotional and other forms of expression. Besides, the world of the twenty-first century will be much more technological than the world of today. For living a useful life in such a society, a sound base of science is necessary.

Science does not consist of facts and memorising of facts. It is through a process of discovery which science provides that a person develops his reasoning and judgment. But, the discovery approach for science cannot be adopted without experimentation. Experiments require tools, gadgets and apparatus. All these cannot be purchased without incurring heavy expenditure. Therefore, only way out is for the teachers and all concerned to improvise science teaching kits. How to proceed in this direction is really the basic question. All my colleagues in the Department of Science Education have applied their minds to this task. Dr. M.C. Pant can justly claim leadership. Mr. B.K. Sharma and Dr. Bukhalov have spent hours to find solution to many ticklish problems. They are both extremely technical in the fullest sense of the term. This book provides valuable information and guidance for improvising science teaching kits. Mr. B.K. Sharma and Dr. Bukhalov deserve the warmest congratulations for preparing this book.

It is to be expected that there would be some limitations in a book of this type. Therefore, all readers are earnestly requested to send their comments, criticism and suggestions. They will be gratefully acknowledged and made full use of in bringing out a subsequent edition.

S.V.C. AIYA
Director, NCERT

New Delhi-16
18.8.1972

Acknowledgement

THE brochure owes its existence to the inspiring leadership of Dr. M.C. Pant, Head of the Department of Science Education, NCERT. He provided necessary guidance to the development of prototypes, suggested alternatives and patiently watched the try-outs. Having covered the primary and middle stages, he motivated preparation of this brochure for the use of the various agencies implementing the Project as well as for the foreign guests who frequently visit the Department and wish to know about the activities and plans of the Department in a short time. He took personal interest in scrutinizing the draft of the manuscript and also edited it.

The authors are very grateful to Prof. S.V.C. Aiyar, Director, NCERT, who despite his busy schedule spared his precious time to go through the manuscript. The brochure would have been incomplete but for his valuable suggestions and ideas included afterwards.

We also appreciate the co-operation extended by the subject specialists, both UNESCO and Indian, working in the Department of Science Education in scrutinizing the draft of the manuscript relating to a particular kit. For the Primary Science Kit, the authors are particularly grateful to Dr. B.D. Atreya who spent quite some time on this. In the area of Physics, Dr. M.F. Kolpakov, UNESCO Consultant, Prof. B. Sharan, Prof. J. K. Khurana and Prof. Chhotan Singh provided the necessary expertise. In the area of Chemistry, this was done by Dr. L.V. Levchuk, UNESCO Consultant and Prof. N.K. Sanyal and in Biology by Dr. V.I. Galakhov, UNESCO Consultant and Prof. S. Doraiswami of the Department of Science Education.

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AUTHORS

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1. Introduction

In the age of fast-developing technology, it has become necessary for all countries, especially the developing ones, to reorganise and improve the teaching of science throughout the school stage, especially because it is through science that we get the fundamental base to develop technology and use it for the betterment of mankind. The present-day children are far more informed than their fathers and fore-fathers at their age not on account of some special training but mainly on account of their enriched man-made environment. The recent developments in the use of electricity and electronics are no longer a wonder as they used to be fifty years back. Battery-operated transistorised radios have reached the far-flung areas of the country. Even the tiniest and the remotest village will have a few such sets, if not more.

Although the child takes such innovations as a matter of fact, yet his curiosity regarding the working of such wonderful gadgets is fully aroused. Naturally, he wants to know how and why they function. He is anxious to learn about the world he lives in. He wishes to make things with his own hands, and finally he wants to establish his own logic about the basic laws of science.

The need for improving the educational system in the country was felt and several efforts were made to improve the teaching of science in the post-independence era. The problem was immense, the expenditure involved was too much and the existing physical facilities in schools were almost

negligible. Yet, there was a need for a centralised effort.

In early sixties, the matter was taken up by NCERT in all seriousness. A department of science education was set up to make such an effort. This Department surveyed the existing patterns in the various States and planned a project which is financed by the Ministry of Education, the UNESCO and the UNICEF. New books were written, teacher guides and laboratory manuals were prepared and the responsibility of improvising laboratory equipment was given to the Central Science Workshop.

The main emphasis of the Project is on *learning science by doing*, which gives a key-role to the improvised apparatus. So far, laboratory apparatus has been improvised up to the middle school level. The work on secondary level will be taken in hand from next year. This apparatus, made of indigenous material, is contained in a box, which facilitates its movement from one classroom to another. Many of the items are available even in small towns and others could be made in ordinary engineering workshops. The apparatus, popularly known as science kits, are of two categories, (i) for demonstration, and (ii) for pupil's experiments. Every effort was made to reduce the cost to the barest minimum so that these kits could be within the reach of every school. The total cost of complete laboratory for elementary and middle school consisting of 10 kits may be about Rs. 2000 only.

Further details of these kits are given in this brochure.

2. Educational Pattern

THE educational pattern in India is a complex one and the complexities are so great that anything which succeeds in India can be looked upon as something which would succeed elsewhere.

There are 21 States and 8 Union Territories in the country and each of them is free to take its own decisions on not only the pattern of education but also on all problems connected with it. Education is financed by State Governments. There are about 5,00,000 primary schools, about 1,00,000 middle schools and over 30,000 secondary schools. Over 75 per cent of the primary and middle schools are in rural areas. About 40 per cent of the primary schools are single-teacher schools. There are 15 Indian languages recognised in the Constitution of India. In addition to these English and about 42 dialects are used as media of instruction. The medium of instruction in the secondary stage is ordinarily one of the languages included in the Constitution of India or English.

The School System

The pattern of school system is not exactly the same in all the States and Union Territories. There are variations but they are not very large. Hence, it is possible to attempt a rough generalisation.

In some States school education is spread over ten years and in others eleven years. Thus, there are two patterns in general, depending upon the number of years

for school education. They consist of three school stages—Primary or Elementary during the first four or five years, Middle or Junior High during the next three years and High or Secondary School in next two or three years. Primary School, therefore, has either Classes I to IV or I to V. Middle school caters either for Classes I to VII or for Classes I to VIII. A high or secondary school has either Class V to X or Classes VI to X (XI). There are also some secondary schools having only Classes VIII to X or IX to XI. Besides there are special schools and public schools.

The responsibility of framing curriculum up to the middle school stage is that of the State Governments or of the Union Territory Administration. They also arrange final examinations at each of the two stages. In the case of secondary schools, these aspects are looked after by the Boards of Secondary Education of the States.

Teacher Education

A teacher for elementary and middle school is trained in institutions known as Primary Teacher Training Schools. These institutions usually admit boys and girls who have successfully passed the examinations for Secondary School Leaving Certificates (SSLC)). Until recently, the course of teacher education was of one year's duration. Now it has become, or is fast becoming, a two-year course in most of the states.

Teachers for secondary schools are educated in the Teacher Training Colleges or

Colleges of Education. They admit university graduates. Duration of this course is of one year, which leads to B. Ed. degree after successful completion of the course.

Nowadays trained teachers with first degree in Arts or Science and B. Ed. are

also employed to teach the middle school classes in high schools having middle sections or some large independent middle schools. For higher secondary classes a teacher must possess a master's degree as well

3. Present Position of Science in the School Curriculum and Attempts made so far for its Improvement

SCIENCE in some form or other is taught right from Class I in all the states of the Indian Union. In Classes I-V, it is taught under different names as elementary science, nature study, general science or health, hygiene and physiology. In Classes VI-VIII it is mostly taught as general science or everyday science. The subject is more or less a compulsory one for all the students up to Class VIII, though there are some exceptions. At the high school or higher secondary stage, different practices are followed in different States. In some States the subject is taught to all the students as compulsory general science and also as elective science disciplines to those who want to offer these as optional subjects.

In some States Science is taught as optional science disciplines only, and no compulsory general science is taught at this stage, while in others it is taught as compulsory general science for all the students.

In Classes I-VIII the science teaching is not accompanied with regular individual laboratory work. At the higher secondary stage, most of the States provide for an individual laboratory programme where science is taught as an elective science. In a couple of States there is no provision for individual laboratory experiences to the children even at the secondary stage.

Although much emphasis is put on providing science education at school, the traditional lecture method of teaching science is mostly in use. There are no laboratories, no demonstrations and no experiments by students in the primary and middle schools. Even the teachers are not properly trained for this task. This results in great difficulties in developing the desired scientific attitudes in the pupils. The teacher just explains the basic laws of science and tries to give examples. Students are only silent participants in this process. They never get an opportunity to verify teacher's assertions by doing some experiments or to inquire into or investigate the various scientific phenomena. The idea that children, suitably encouraged, can form their own hypotheses, test them by observation and so discover some nature's laws for themselves, has been almost alien to teachers. Students who choose science as an elective subject at secondary stage may have laboratory facilities but others never get an opportunity to do experiments.

The existing curricula in the teacher training institutions do not include science content. Usually in either of the two types of institutions there is only one science teacher for teaching the 'general methods of teaching science'. Since there are no labora-

tories, teaching aspect remains more or less theoretical. A teacher thus educated will be poorly equipped with competencies required for the job.

During the Second and the Third Five Year Plan periods, a number of schemes were taken up for the improvement of science education at the school stage. The efforts were mainly directed towards improving the provision of elective science courses in the higher secondary schools, revision of the syllabi, strengthening of the laboratory and library facilities and short-term in-service courses for teachers through summer institutes. The establishment of the National Council of Educational Research and Training and a separate Department of Science Education within this body with a view to providing leadership and organising new programmes of science education is another major step in the total programme of improving science education. The establishment of four Regional Colleges of Education, where a special programme of four-year

training in content-cum-pedagogy is organised for science teachers of secondary schools, it is hoped, will establish new standards of training of science teachers and help in solving the problem of the shortage of science teachers to some extent.

The various efforts made up to the end of the Third Plan period were continued with more inputs during the Fourth Five Year Plan period. Some new important features were the establishment of 20 study groups in various universities and research institutes for developing new curricular materials in science and mathematics for the school stage.

The main effort from the central level was directed towards providing assistance to the States to try out new curricular materials in selected schools under a pilot project assisted by UNICEF. This would enable the States to develop their own versions of new courses in the regional language after a scientific try-out.

4. The Project

WITH a view to reorganising and expanding the teaching of science for as many students as possible throughout the school stage in order to develop the scientific attitude and scientific literacy in the students, a project, popularly known as UNICEF aided Project has been launched. The UNESCO had already provided assistance in the shape of equipment for laboratories and workshop, foreign expertise and training facilities abroad for Indian counterparts under the Secondary Science Teaching Project for developing an up-to-date and upgraded curriculum in science and mathematics for the secondary stage.

As indicated earlier, each State was required to select 50 primary and 30 middle schools for the try-out of the curriculum material and science kits developed. For this purpose full assistance was provided by the Government of India and the UNICEF to the states for translating the materials, for the training of the teachers and for the

supply of NCERT kits. Besides this, selected key institutions like the State Institute of Science Education, State Institutes of Education, Teacher Training Colleges and Teacher Training Schools were also equipped with complete set of science laboratory equipment to enable them to play their role in training and supervising teachers involved in trying out the new curricula in Pilot Project schools and also to strengthen pre-service training of teachers.

Since then, it has been decided to enlarge the pilot phase to a phased wider introduction of new curricular materials. Under this, 24,000 primary and 31,000 middle school kits developed by NCERT are to be supplied by the UNICEF to various States/ Union Territories. This would cover about 5 per cent of the total primary and 35 per cent of the total middle schools. Production of such a large number of kits will give a boost to the industry and bring down the price level.

5. Science Kits

THE main objective of the project is to upgrade and update the teaching of science throughout the school stage and to ensure the active participation of the students in the teaching-learning process by providing first-hand science experiences. This is to be achieved by involving children in doing experiments and discovering the various facts, laws and generalisations for themselves. The teacher provides motivation and necessary guidance. In order to implement this new methodology in actual classroom, suitable apparatus has been improvised using indigenous materials and has been collected and organised in the form of 'Science Kit'. These kits are portable and act as mini-laboratories, suitable for use even in an ordinary rural school without the facilities of separate science rooms or conventional laboratories. The cost has been reduced to the minimum, utilising most of the items which are readily available in the local markets. Items are simple in operation and sturdy in construction so that the children can use them without any fear of damage. These kits provide the following additional advantages :

- (i) Availability of necessary items at one place.
- (ii) Multipurpose use of items.
- (iii) Economy of time in setting up.
- (iv) Economy of consumable materials.
- (v) Portability from one room to another.
- (vi) Provision for teacher's innovation.

(vii) Low cost and use of indigenous resources.

(viii) Easy replacements of lost or broken items

The kit guides have been prepared which contain a list of the items, their sketches and detailed description. This facilitates the replacement of any part that is rendered unserviceable in use. Some of the experiments are also illustrated.

The kits are of two types. One category of the kits is meant for the classroom demonstration by teachers and the other for pupil's experiments. Some kits serve both the purposes by the addition of a few sets of items available in the local market, depending upon the size of the class. The demonstration kits have been designed for a class of 35-40 students. Items meant essentially for demonstration purposes are of large size so that a child at a distance of 6-8 metre can also see the details. Similarly, a 'Pupil's Kit' can serve a class of 35-40 students. They also contain consumable materials like chemicals etc. for a year's use except those chemicals which are to be handled with utmost care or can be procured more easily locally.

The kits developed so far cover the primary and middle (Junior High School) stages of the secondary schools. At the primary stage, whatever may be the syllabus, the kit will be quite useful as it will cover most of the topics. At the middle stage the kits are quite adequate to cover physics, chemistry

and biology as the General Science even up to Class X. Hence the kits developed would adequately cover the laboratory needs of the first ten years of schooling. Further, although special curriculum has been developed from Class I to XI and based on this, books have been written, but a book prepared for Class VI can be used for Class VII also, if so required. It is, therefore, suggested that all the kits for physics for various classes taken together should be looked upon as a combination useful to teach physics.

The process of development of the kits is also interesting. It is the outcome of the sustained and laborious efforts of a team of subject specialists, engineers, materials experts costing advisers and market surveyors. Ideas were originated by the subject experts, both UNESCO Consultants and Indian counterparts. They also provided necessary information regarding the availability of some type of apparatus in the market for this purpose. If available, this was purchased and examined by engineers (both UNESCO and Indian counterparts) for quality, cost, suitability, availability (whether imported or indigenous) etc. When it satisfied the manifold requirements, it was included in the kit, like a small magnetic compass at a cost of one rupee or

student's microscope at the cost of Rs 10/- developed by an Indian firm. In most of the cases, however, the apparatus was to be improvised to suit the requirements of the new curricula and methodology of teaching science. The team held discussions and the requirements were studied. As a result a prototype was developed. This was tried out in the laboratories of the Department. Results of close observations were conveyed to the prototype developing team. Modifications found necessary were made and the prototype was tried in a real school situation. Reactions of the pupils and teachers were noted and further modifications made, if necessary. Thus the prototype was born.

This prototype was then passed on to the Design Office for making detailed drawings. It was at this stage that the prototype underwent slight modifications from the point of view of interchangeability of its parts and process planning. Blue prints then rolled out of the section and along with the prototype found their places in the Inspection and Quality Control Section. This section laid down standard specifications, schedule of inspection and suggestions for further improvements.

6. Details of Kits Developed so far

A List of the kits developed so far is given below. A complete set provides the entire laboratory equipment for primary and middle schools. There are ten kits including four for pupil's experiments. The total cost of all these kits is presently around Rs. 2000 but it could be reduced substantially by commercial exploitation on mass scale.

D.S.E. (C.S.W.) I	Primary Science Kit (complete laboratory for primary schools.)
D.S.E. (C.S.W.) II	Physics Demonstration Kit No. I
D.S.E. (C.S.W.) III	Physics Pupil's Kit No. I
D.S.E. (C.S.W.) IV	Physics Demonstration Kit No. II
D.S.E. (C.S.W.) V	Physics Pupil's Kit No. II
D.S.E. (C.S.W.) VI	Biology Demonstration Kit for middle stage

D.S.E. (C.S.W.) VII	Chemistry Demonstration Kit for middle stage
D.S.E. (C.S.W.) VIII	Chemistry Pupil's Kit for middle stage
D.S.E. (C.S.W.) IX	Physics Demonstration Kit No. III
D.S.E. (C.S.W.) X	Physics Pupil's Kit No. III

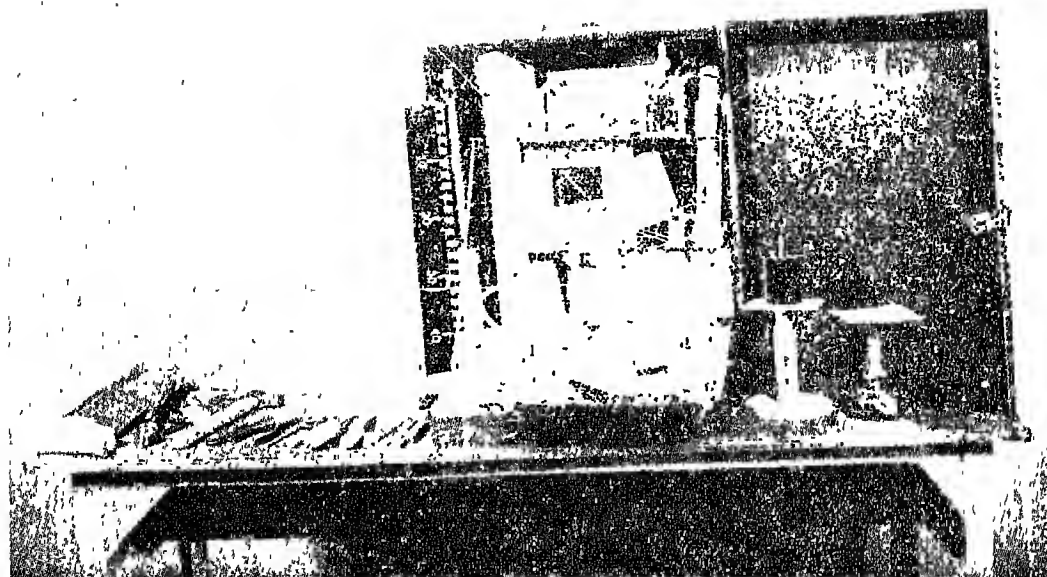
(Kits Nos. II to X cover the entire new science curriculum proposed for the middle school stage. These kits can very profitably be used even to cover the existing SSLC/Matriculation courses in science prescribed in most of the States)

Earlier, another kit, known as Biology Demonstration Kit No. I, was also developed for the first year of middle stage. Ultimately, this has become a part of C.S.W. Kit No. VI.

A brief description and salient features of each of the kits are given in the following pages.

PRIMARY SCIENCE KIT

D.S.E. (C.S.W) I



This provides a complete portable laboratory for all the 4 or 5 years of the primary stage. With the addition of a number of items which are locally available, about 40 children can perform their experiments in groups or sometimes individually. Built in the kit box are collapsible demonstration table and a chalk board which make it a self-contained laboratory. The teacher can use it in the classroom as well as in the open, either in the shade of a tree in summer or in sunshine in winter. The kit has a special compartment for hand tools and all essential hand tools have been provided so that the teacher can prepare his own improvised equipment or undertake minor repairs

to the kit apparatus if so required. There is also a special compartment for a set of instructional charts in the kit box.

With the dimensions of the kit box as 450 × 125 mm and 600 mm height it eliminates all storage problems. It can be placed inside a cupboard or in the corner of a room. If carefully packed, it could be kept in any position. A kit guide is supplied along with the kit. This contains a list of the general items, hand tools, consumable materials, chemicals and set of instructional charts. Sketches, brief description and uses of the items have been provided and a few experiments illustrated. Wherever found necessary, details of the parts of

assemblies have been given.

Reference Books Published (NCERT)

(a) Textbooks

- (i) Science is Doing for Class III
- (ii) Science is Doing for Class IV
- (iii) Science is Doing for Class V

(b) Teacher's Guides

- (i) Teachers Guide to Science is Doing for Class III
- (ii) Teachers Guide to Science is Doing for Class IV
- (iii) Teachers Guide to Science is Doing for Class V

(c) Teacher's Handbooks of Activities

- (i) General Science—A Handbook of Activities for Primary Schools, Vol 1,
- (ii) General Science—A Handbook of Activities for Primary Schools, Vol. 2,
- (iii) General Science—A Handbook of Activities for Primary Schools, Vol 3

(d) Kit Guide

Scientific Topics covered under New Curriculum

- 1 Our Universe
- 2 Air, Water and Weather
- 3 Rocks, Soils and Minerals
- 4 Forces and Work
- 5 Matter and Materials
- 6 Housing and Clothing
- 7 Living Things
- 8 Plant Life
9. Animal Life, including a separate chapter on Birds in Class III
- 10 Man and His World (In Class V only)
11. Human Body Health and Hygiene

List of the Kit Contents

I GENERAL ITEMS

1. Aluminum *katori* (a cup without handle) 100 mm dia—2
2. Balls (rubber) 80 mm. and 50 mm. dia.—1 each
3. Beaker 250 ml and 100 ml.—1 each
4. Hard glass test tube—1
5. Compass needle—1
6. Electric circuit-board with battery, bulb and switch—1
7. Enamelled copper wire 24 gauge—2 metres

8. Football pump—1
9. Glass marbles—50
10. Glass jar or empty jam bottle—1
11. Glass rod 15 mm dia. \times 150 mm long—1
12. Hand fan—1
13. Hand lens (mag 4 \times) with plastic frame—1
14. Hard board 200 \times 200 \times 3 mm with rectangular slot of 80 \times 80 mm in centre—1
15. Hollow polythene rectangular containers of same capacity but different sizes—1 each
 - (a) 120 \times 60 \times 30 mm height (red)
 - (b) 90 \times 30 \times 80 mm height (blue)
16. Kitchen strainer (wire-net)—1
17. Magnet bar—1 pair
18. Measuring cylinder 100 ml—1
19. Aluminium tube 60 mm dia. \times 125 mm long—3
20. Soft iron nails 6 mm dia \times 130 mm long—2
21. Mounting needles—2
22. Plane mirror mounted on wooden base 100 mm. \times 60 mm —1
23. Plastic comb —1
24. Plastic funnel 75 mm dia —1
25. Tubing 7.5 mm dia. (Polythene)—1 metre
26. Plastic tumbler 100 mm high —2
27. Plastic syringe—1
28. Polythene bags assorted —6
29. Pulley—1
30. Rubber stoppers assorted for item No 4—2
31. Rubber stoppers assorted for item No 36—3
32. Scale half-metre with five holes—1
33. Sieve 125 mm dia.—1
34. Lamp (kerosene)—1
35. Spring balance 1 kg —1
36. Test Tubes 15 mm dia \times 125 mm long—6
37. Thermometer 0—110 C on wooden base—1
38. Thermometer clinical—1
39. Torch with 2 cells—1
40. Tripod stand with wire gauze—1 each
41. Water wheel—1
42. Wedge—1
43. Wind-van—1
44. 1 kg. weight—1
45. M.S. Wire 3 mm dia. 200 mm long—1
46. Glider—1
47. Top pan spring balance 2 kg.—1
48. Model of Lift pump—1
49. Toy electric motor—1
50. Kit Box

II HAND TOOLS

1. File triangular (100 mm)—1
2. Hammer with claw (250 gms)—1
3. Hand Drill (6 mm. dia. capacity) with drill bits —1

- 4 Knife with wooden handle (blade 100 mm long) —1
- 5 Pliers (150 mm) —1
- 6 Tennon saw (blade 250 mm long) —1
- 7 Tin cutter, straight —1
- 8 Screw driver, 100 mm —1

III CONSUMABLE MATERIALS

- 1 Filter paper —2 sheets
- 2 Candle (medium) —1 packet
- 3 Card board —1 sheet
- 4 Cotton thread —1 ball
- 5 Cellophane sheets —30 cm sq
- 6 Iron nails assorted —1 packet
- 7 Drawing pins —1 packet
- 8 Plasticine —50 gms
- 9 Rubber balloons assorted —1 dozen
- 10 Rubber bands —1 packet
- 11 Sand paper —1 sheet
- 12 Sealing wax —2 sticks
- 13 Straws —1 dozen
- 14 Steel Wire (24 S W G) —11 metre

IV CHEMICALS

A Containers for chemicals

- (1) Plastic phials —6
- (2) Plastic dropping bottles —2
- (3) Plastic container of 2 oz capacity —2

B Chemicals to be arranged locally

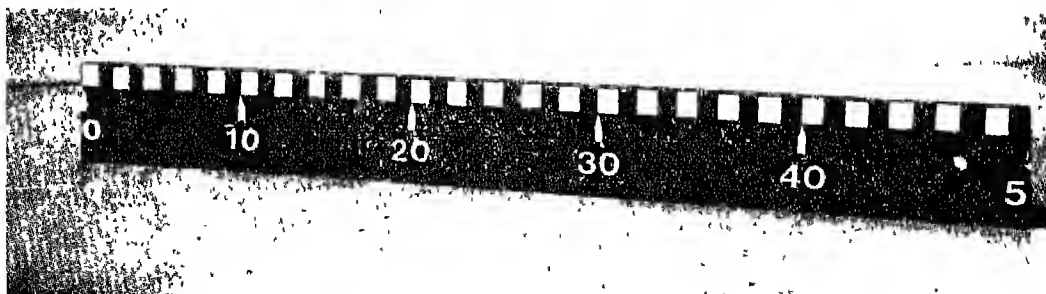
- (1) Ammonium phosphate —50 gms.
- (2) Ammonium sulphate —250 gms.
- (3) Caustic Soda —250 gms
- (4) Copper sulphate —100 gms
- (5) Glycerine —1-2 gms
- (6) Iodine —2 gms
- (7) Common Salt —100 gms
- (8) Methylated spirit —50 gms
- (9) Potassium permanganate —50 ml
- (10) Sugar —250 gms.
- (11) Vaseline/petroleum jelly —50 gms
- (12) Washing Soda —100 gms.

V A SET OF CHARTS

It is proposed that a set of charts will also be supplied.

Examples of Improvisations

1. SCALE HALF METRE WITH FIVE HOLES (Item No. 32.)



Requirements

- (i) Mainly for demonstration purpose.
- (ii) Should be able to impart the idea about submultiples of metre to children.
- (iii) Visible from a distance of six metres.
- (iv) Sturdy enough to work as a lever.
- (v) Light enough to be handled by children

(vi) Should not be costly.

Uses

- (i) For measuring distance.
- (ii) To draw lines on blackboard.
- (iii) To act as a lever.

Concepts

- (i) Measurement of lengths
- (ii) Principle of lever.

The Prototype

The prototype satisfies all requirements. It is made of soft wood with black base. Each graduation in white as well as black

corresponds to one centimetre which is clearly visible from a distance of six metres. Loads could be suspended to enable it function like a lever. It is quite inexpensive.

2. LAMP (KEROSENE) (S No. 34)



Requirements

- (i) To be a source of heat for experiments.
- (ii) Parts to be replaceable.
- (iii) Fuel should be available in small villages.
- (iv) Simple in operation and handling.
- (v) Should give smokeless flame.
- (vi) Should be inexpensive.

Uses

- (i) As a source of heat.

Concepts

- (i) Heat energy.

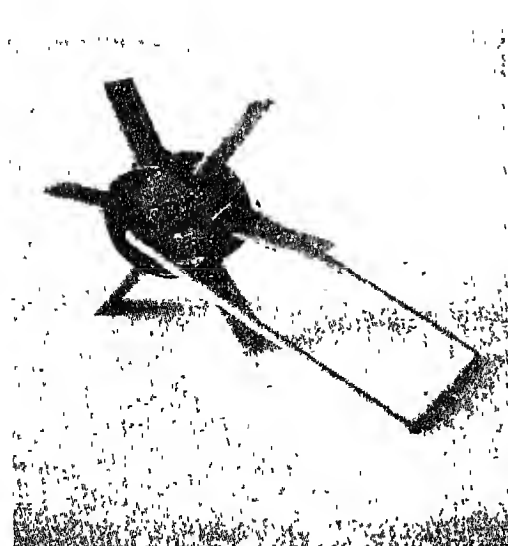
Availability

Available as a spirit lamp but the fuel spirit is not easily available.

In fact the requirements were to improve a substitute for a spirit lamp, since spirit is not available in villages. The task was to design a smokeless kerosene lamp from ordinary material.

The Prototype

The prototype fulfils all the needs and offers a great flexibility in using different size of ink bottles. Stopper is made of hard rubber (ebonite) having three steps for normal sizes of ink bottles available in the country. The wick is made of unspun cotton which is available everywhere.

3. WATER WHEEL (*S. No. 41*)**Requirements**

- (i) A device to indicate conversion of energy of the falling water stream into mechanical motion.
- (ii) Should be light and portable.
- (iii) Should be small and simple in construction.
- (iv) Should be inexpensive

Uses

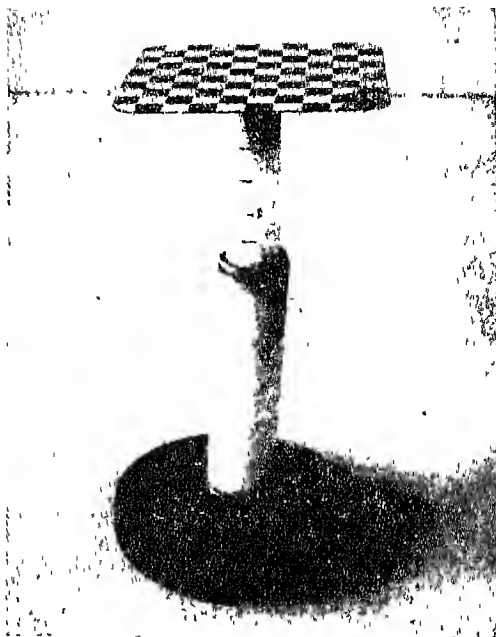
- (i) As a small water wheel.

Concepts

- (i) Conversion of energy

The Prototype

The prototype satisfies all the requirements. It is small and light so that children can easily handle it. The experiment can be performed either by using a water tap or by providing a small hole at the bottom of a water container. It is frictionless and works even on blowing air from mouth.

4. TOP PAN SPRING BALANCE—2 Kg
(*S. No. 47*)**Requirements**

- (i) A simple device for measuring weight.
- (ii) Both for demonstration and pupil's use
- (iii) Convenient to handle.
- (iv) Easy to illustrate its working.
- (v) No precision weighing required.
- (vi) Inexpensive.

Uses

- (i) For weighing.

Concept

- (i) Measurement of weight.

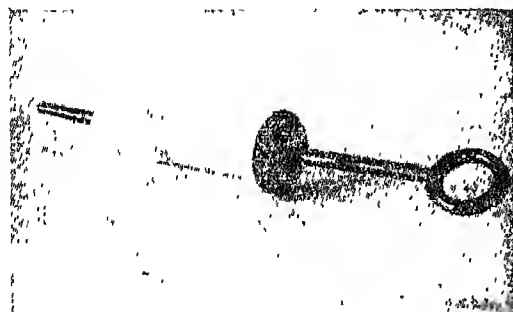
Availability in the market

Either hanging type spring balances or

The Prototype

The prototype meets all requirements. It carries four graduations of $\frac{1}{2}$ kg. each which are visible from a distance. The top provides an easy handling. The result of weighing can be known immediately without any other efforts. Hanging by means of hooks and strings is altogether eliminated. Various parts can be dismantled for showing to children.

5. MODEL OF A LIFE PUMP (S No 48)



Requirements

- (i) Device to illustrate the working of a lift pump.
- (ii) A small and simple model which can be handled by children
- (iii) To allow visibility it should be made of transparent material.
- (iv) Should be inexpensive.

Uses

- (i) To illustrate the working of a lift pump.

Concept

Principle of lifting water through the use of air pressure.

The Prototype

The prototype is a very simple and cheap device to meet the requirements. Body made of transparent polystyrene allows vision of the functioning of seat valve so that the teacher can guide the students as to what is happening inside. It could be handled by the students as well.

LIST OF ACTIVITIES

Class 3

<i>S. No.</i>	<i>Name of the Activities</i>	<i>Equipment and Materials</i>
CHAPTER 1 OUR UNIVERSE		
1	Why does the earth appear to be flat?	Large ball, water pot or a globe, small ball and a round small-coin
2	How is it possible to travel around the earth ?	A large ball, globe or water pot, a small stick, a piece of chalk
3	What causes night and day?	Large ball, water pot or globe, Petromax, torch or candle, chalk
CHAPTER 2 AIR, WATER AND WEATHER		
4	What happens to ice when it melts?	Ice, metal tumbler or tin can
5	What happens when you wet your hands and blow on them?	Hand fan or cardboard, water
6	Does the air temperature vary during the day?	0°-110° Celsius (or Centigrade) thermometer
7	Is the temperature higher in the sun or in the shade?	A 0°-110° C thermometer
8.	Why is the sun warmest when directly overhead?	Cardboard or heavy paper, 30 cm square, scissors or blade

- 9 How can we make and use a wind vane?

A bamboo or stick 50 cm long, a piece of wood, 20-30 cm. long and 3 cm square

CHAPTER 3 · ROCKS, SOILS AND MINERALS

- 10 Do soil particles differ in size?
 11 What materials do you find in soil?
 12 Which soil holds most water clay, sand or loam?
 13. What is formed when two rocks are rubbed together?
 14 In what other ways are rocks weathered?

Sand, clay, hand lens, soil samples
 Glass tumbler containing soil sample
 3 flower pots, 6 bricks, 3 tumblers, samples of clay, sand and loam
 Hand lens, 2 rock pieces
 Hand fan, piece of newspaper, sand

CHAPTER 4 . FORCES AND WORK

15. What is force?
 16. How do we use forces when we play?
 17. What happens when you kick a ball with two different forces?
 18 What is the force that comes from gravity
 19 Does the weight of an object exert force on the surface on which it rests?
 20 Does any force come from a magnet?
 21 Is there any force in electricity?
 22 How do our muscles exert force to do our work?
 23 Why do carts have wheels?

—
 None needed
 Ball, large field
 Ball, brick or stone
 Top pan balance, 2 bricks
 Magnets, nails, other small objects
 Comb or pen, soft nylon cloth or terylene cloth or cotton cloth, small pieces of paper
 Brick, table or desk

- 24 What do we mean by friction?
 25. How can we measure area?
 26. What do we mean by temperature?

Brick, smooth and rough surfaces, rollers such as round pencils
 —
 Sheets of paper, metre scale or other suitable scale
 Glass jar or tumblers, thermometer, hot and cold water, ice

CHAPTER 5 · MATTER AND MATERIALS

27. What is the difference between a solid, a liquid and a gas?
 28. How can matter in one state be changed into matter in another stage?
 29 Can water-vapour be changed back into water or ice?
 30 What are the shapes of solids, liquids and gases?
 31 How do we know that air occupies space?
 32. What is air pressure?
 33 Can salt be dissolved in water?
 34. Will hot water dissolve more salt than cold water?

Water, stone
 Ice, tin can
 Metal plate, pot
 Stone, tumbler, ink, water
 Small glass jar, piece of paper, bowl of water
 Sheet of newspaper, 20 cm. scale
 Glass jar, salt
 Metal pot, water, salt

CHAPTER 6 HOUSING AND CLOTHING

- 35 How does a house provide shelter and comfort?
 36 How does one make a sump in the garden?

Discussion based on observations
 Discussion based on observations

CHAPTER 7 LIVING THINGS

37. Do plants grow?
 38 Do snails and earthworms react to their surroundings?

Flower pots, soil, bean or other seeds
 Burner, glass or metal rod, snails and earthworms, sheet of paper

39 Do plants react to light?

40 Do plants reproduce?

2 cardboard boxes, 2 flower pots, 2 similar plants

Flower pots, seedlings, soil

CHAPTER 8 PLANT LIFE

41 What are the parts of a plant?

42 Are roots essential for plant growth?

43 Why are roots essential for plant growth?

44 How do water and salts from the roots rise up to the leaves?

45 What is the work of a flower?

46 What is a plant life cycle?

A plant, water, sheets of paper

Flower pots, plants, soil

2 glass jars, 2 garden plants, red ink

Beaker or glass jar, red ink, hand lens, razor blade

Flower garden

Flower pots, seeds or seedlings of a plant with a short life cycle—such as pea, bean or mustard

Metal bowl or pot, burner, stand for pot, soil, and water

2 flower pots, crushed brick dust, garden soil, bean seeds

Garden soil, glass jar, water, hand lens

47 Does soil contain salts?

48 How do these salts help the plant grow?

49 What things make up the humus of the soil?

CHAPTER 9 ANIMAL LIFE

50 How do birds eat?

51 What special features are found in the teeth of meat-eating animals?

52 How do we know that even meat-eaters depend ultimately on green plants for their food?

Discussion based on observations

Discussion based on observations

Discussion based on observations

CHAPTER 10 BIRDS

53 What is it in their wings that help birds to fly?

54 How do the wings and tails of birds help them to fly?

55 How do ducks, geese and other water birds keep themselves dry?

56 How do the feet of ducks help them to live on water?

57 How can we use a bud table?

Discussion based on observations

Pieces of paper, model glider

Freshly plucked feathers from a duck and a hen, basin of water

Pieces of cardboard, rubber bands or strings, pail of water

Pole or post 1– $\frac{1}{2}$ metres in length and 10 cms. in diameter

As many different nests as the children may gather

CHAPTER 11 YOUR BODY AND HEALTH

59 How does chewing help in digestion?

60 What pumps the blood throughout your body?

61 Does the heart always beat at the same rate?

Pieces of *chapati* or bread

Chart

A clock or watch with a seconds' hand would be useful.

62 What happens to your chest when you breathe in and out?

A piece of string about a metre long

63 What waste is removed from our lungs when we breathe out?

A small mirror

Class 4

CHAPTER 1 OUR UNIVERSE

1 What is a planet?

2 How do these planets orbit around the sun?

A rope or piece of string

Rope, two sharp sticks

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| 3 | Why do the other stars not give us heat and light? | Candle |
| 4 | Why are the stars not visible during the day? | A piece of black or brown paper, at least 50 cm square |
| 5 | What does a constellation look like? | do |
| 6. | How are volcanoes formed? | Plastic bag, mud, pin |
| 7 | How do positions of the earth change as it orbits the sun? | A globe or a ball and a pump |

CHAPTER 2 : AIR, WATER AND WEATHER

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|-----|--|--|
| 8 | How does the sun affect land and water? | Two wide mounted basins, measuring cylinder, spring balance, thermometer |
| 9. | What happens to water when it is left in a vessel for some time? | A glass jar, strip of paper, glue |
| 10. | Does water evaporate more rapidly in the sun or in shade? | Two bowls, water |
| 11. | Does water evaporate faster on a windy day? | Two pieces of cloth of the same material and of equal size, hand fan or electric fan |
| 12. | Does the extent of surface area affect evaporation? | Two pieces of cloth, water |
| 13. | What happens when water vapour is cooled? | A kettle or pot of water, a metal plate, a burner |
| 14 | What is safe water? | Bucket to collect rain water |
| 15 | How do we make water safe for drinking? | Two glass jars, rubber tube, flower pot, sand, piece of cloth |
| 16. | How is water stored underground? | Tin can and sand |

CHAPTER 3 : ROCKS, SOILS AND MINERALS

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|-----|--|--|
| 17. | What do soil layers look like? | Spade |
| 18. | How does water wash away the top soil? | Spade or shovel, sand or light soil |
| 19 | How does wind blow away the top soil? | Sand, piece of paper, book or hand fan |
| 20 | How do we protect the top soil? | Two empty boxes, sand, turf, water, watering can |
| 21. | How is soil protected by terraces? | Two boxes, supply of stones, sand or soil |

CHAPTER 4 : WORK, ENERGY AND MACHINES

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|-----|---|---|
| 22. | How is the energy of falling water used to do work? | Empty cotton reel, metal sheet, metal rod or nail, bucket, water |
| 23. | How is the energy of steam used to do work? | Water wheel, kettle of boiling water |
| 24. | How is the energy of electricity used to do work? | Electric motor, copper wire, battery, switch |
| 25. | How is electricity used to make a magnet? | Copper wire, battery, large nail, small nails, circuit board |
| 26. | Do we produce heat when we do some work? | Two pieces of stone |
| 27. | How does a simple machine help us to do work? | Wooden plank |
| 28 | How do pliers help us to do work? | Hammer, pliers, nails, wooden board, pliers, scissors and nutcrackers, if available |
| 29 | What is lever? | Short plank, two or three bricks, a small stone |
| 30 | What is volume? | Empty bottle, measuring cylinder |
| 31 | How much is a litre? | A hollow cube of one litre capacity, measuring cylinder, scale |
| 32. | Do solids of equal volume have equal weight? | Top pan balance or spring balance, 3 or 4 blocks of different materials, e.g., iron, wood, lead and aluminium |

CHAPTER 5 . MATTER AND MATERIALS

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|-----|--|---|
| 33 | Do all things change when they are heated? | Wax, teaspoon, sugar, burner |
| 34 | What happens to potassium permanganate crystals when they dissolve in water? | Beaker or glass jar, potassium permanganate crystals |
| 35 | When solids dissolve in water, does the water level change? | Jar or tumbler, piece of sticky paper, salt, teaspoon |
| 36. | What happens to the salt when it dissolves in water? | Empty jam jar 50 marble pieces, 200 gms of green gram |
| 37 | How do we know that water dissolves gases? | Bottle of any aerated water |
| 38 | Are there gases dissolved in pond, stream, and river water? | Beaker, burner |

CHAPTER 6 HOUSING AND CLOTHING

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| 39 | Why do you feel hot and uncomfortable in a hot, stuffy room? | Beaker, burner |
| 40. | Where does the hot air go? | Incense stick, matches |
| 41. | What kind of materials are house roofs made of? | Pictures of different kinds of roofs |
| 42 | How are clothes made from thread? | Samples of cloth pieces |

CHAPTER 7 LIVING THINGS

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|-----|---|---|
| 43. | What kind of animals and plants live in a pond? | Hand net, empty jam jar for collecting, hand lens |
| 44 | What kind of plants and animals live in dry waste land? | Hand lens, collecting jar |
| 45 | In what sort of places do animals live? | Pictures of animals and their habitats |

CHAPTER 8 PLANT LIFE

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|-----|--|---|
| 46. | Is sunlight needed for plant growth? | Two potted plants, a dark cupboard |
| 47. | Is water necessary for plant growth? | Two healthy potted plants |
| 48 | Do all plants make their own food? | Toadstools and mushrooms, two pots with soil, some bean seedlings |
| 49. | How do toadstools and other non-green plants get their food? | Mouldy bread, decaying fruit |
| 50 | Which plants form the main food of man? | Seeds of rice, wheat, millet |
| 51. | Do animals also use grass plants as their main source of food? | |

CHAPTER 9 . ANIMAL LIFE

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|-----|---|----------------------------------|
| 52. | Which animals give birth to living young? | Discussion based on observations |
| 53. | Do all animals give birth to their young? | do |
| 54 | Do other animals lay eggs also? | do |

CHAPTER 10 HUMAN BODY, HEALTH AND HYGIENE

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|-----|--|--|
| 55 | Why do we eat cooked food? | Some raw rice, potato or any other food which is normally eaten cooked, burner, a container suitable for cooking |
| 56 | Why should we use the water used for cooking vegetables and not throw it away? | Beans |
| 57. | How does food spoil? | Boiled potatoes |
| 58. | How can we make a food cooler? | A plastic dish, garden pot, bricks, large piece of cloth, thermometer |
| 59. | Why is it necessary to have strong healthy teeth? | Raw carrot washed in safe water |

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|---|--|
| 60. Do your teeth help you in any other ways? | Discussion based on observations |
| 61. How many different types of teeth do we have? | do |
| 62. How do we care for our teeth? | Neem twigs, tooth brush and tooth paste or dental powder |

Class 5

CHEPTER 1 : OUR UNIVERSE

- | | |
|---|-------------------------------|
| 1. How are the tides caused? | A ball, a wooden block, torch |
| 2. How do shadows occur? | Two balls, torch |
| 3. How does an eclipse of the moon occur? | Two balls, torch |
| 4. How does an eclipse of the sun occur? | |

CHEPTER 2 : AIR, WATER AND WEATHER

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|--|---|
| 5. How does water rise, when people drink through a straw? | A jar or drinking glass, drinking straw |
| 6. How does a syringe or a fountain-pen-filler work? | Syringe or fountain-pen-filler |
| 7. How does a lift pump work? | Model of a lift pump |
| 8. How can a liquid from one jar be transferred to another without tipping the contents of one into the other? | Plastic tubing, two jars, bricks or blocks to provide an elevated surface |
| 9. Does burning require something from the air? | Candle, two glass jars of different size, match box |
| 10. How is exhaled air different from that which we inhale? | Two test tubes, lime water, drinking straw |
| 11. What happens when a fresh water plant, such as <i>Hydrilla</i> , is kept in a jar of water in sunlight? | <i>Hydrilla</i> plant, jar, filter funnel, test tube |
| 12. How can we obtain dissolved substances from a solution? | Test tube or a metal spoon, common salt, lamp for heating |
| 13. How do we remove insoluble substances from water? | Two tumblers or any other glass containers, muddy water |
| 14. How can water be freed from all insoluble particles? | Funnel, tumbler, filter paper, beakers, glass rod |

CHAPTER 3 : ROCKS, SOILS AND MINERALS

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| 15. What causes the layers to be formed in the sedimentary rocks? | Glass jar, sand, gravel and soil |
| 16. What does an igneous rock look like? | Granite pieces, pestle and mortar, magnifying glass |
| 17. What are the shapes of crystals of common salt, sugar, copper sulphate, alum and marble? | Crystals of common salt, sugar, copper sulphate, alum and marble, hammer, magnifying glass |
| 18. In what different ways are rocks used? | Discussion based on observations |
| 19. What minerals are used as fertilisers? | A chart like that given in the book |
| 20. How are metals like aluminium, copper, silver, and gold used in our modern way of life? | Pictures, articles made of aluminium and copper |
| 21. How is petroleum obtained from the earth? | Some suitable pictures and charts |

CHAPTER 4 . FORCE, WORK AND ENERGY

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|---|---|
| 22. What do we understand by the density of a substance ? | Aluminium, iron and wood blocks, spring balance |
| 23. How many times is milk heavier than water? | Three similar test tubes, water, kerosene, and milk |
| 24. How do liquids exert pressure? | Any cylindrical vessel with holes |

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|-----|--|--|
| 25 | Does water exert pressure in a downward direction? | Water, tin, wax |
| 26. | Are equal pressures exerted in different directions at the same depth? | Empty tin, bucket of water |
| 27 | What is the role of liquid pressure in the floatation of an object? | Dry wood block, spring balance and thread, water |
| 28 | Do objects that sink weigh less in water? | Block of iron, water, spring balance, thread |
| 29. | How does a wedge work? | Knife, wood wedge, metal wedge, razor, chisel, log of wood, and hammer |

CHAPTER 5 . MATTER AND MATERIALS

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|-----|--|--|
| 30 | How far can we go on breaking a chalk stick into pieces? | Chalk stick, a stone to grind the chalk |
| 31 | How far can one go on reducing the size of the particles of any substance? | Test tube, potassium permanganate crystals, hand lens |
| 32 | Does sugar also break into tiny particles when dissolved in water? | Beaker, sugar crystals, spoon, hand lens |
| 33 | Are there spaces between the molecules? | Glass jar, paper strip, gum arabic, teaspoon, salt, other soluble solids such as sugar, alum and copper sulphate |
| 34. | Are the molecules fixed or are they in motion? | Test tube, potassium permanganate crystals |
| 35 | Are the molecules in air in motion? | Discussion based on observations |
| 36 | How can a dissolved salt be recovered from its solution? | Common salt, teaspoon, water |
| 37. | What is the effect of supplying ammonium sulphate to a plant? | Two similar potted plants, ammonium sulphate |
| 38 | What is the effect of a phosphatic fertiliser on the growth of the plant? | Phosphatic fertilisers, two potted plants |

CHAPTER 6 . HOUSING

No activities

NIL

CHAPTER 7 : PLANT LIFE

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|-----|--|--|
| 39. | How many seeds does a single paddy or wheat plant produce? | Ten heads of wheat or paddy |
| 40. | Is water necessary for the germination of seeds? | Seeds of mustard, two pieces of cloth, two pans |
| 41 | Is air necessary for the germination of seeds? | Ten bean seeds, wide mouthed jars (2), a litre of boiled and cooled water. |
| 42 | How are seeds dispersed from the parent plant? | |
| 43. | What kind of a climate is needed for our most important crops? | Discussion based on observations |
| 44. | What are the natural enemies of a crop? | do. |

CHAPTER 8 : ANIMAL LIFE

- | | | |
|-----|---|---|
| 45 | How do fish swim in water? | A jar containing water and a local fish along with some wood or scum from a pond. |
| 46. | How do fish breathe in water? | do. |
| 47. | How do fish feed in water? | A fish in a jar of water, some worms or grubs or some dough |
| 48. | How are water insects adapted to live in water? | A jar containing pond water with common water insects such as backswimmer and other species |
| 49. | How are monkeys adapted to live in trees? | Discussion based on observations |

- | | | |
|-----|---|--|
| 50 | How are the feet of fast running animals suited to their way of life? | Pictures of deer, cattle, horses |
| 51 | Do all land mammals have hard roofs? | Pictures of legs and feet of a wide range of mammals |
| 52 | How are animals that live underground adapted to their way of life? | Some earthworms, burrowing insects or creatures |
| 53 | How do butterflies obtain nectar from flowers? | Discussion based on observations |
| 54. | In what different ways do insects feed? | Collection of beetles, water bugs |
| 55 | How do insects breathe? | The large flying grasshopper or locust |
| 56. | Are the wings of birds like the limbs of other animals? | Wing of bird |

CHAPTER 9 . MAN AND HIS WORLD

No activities

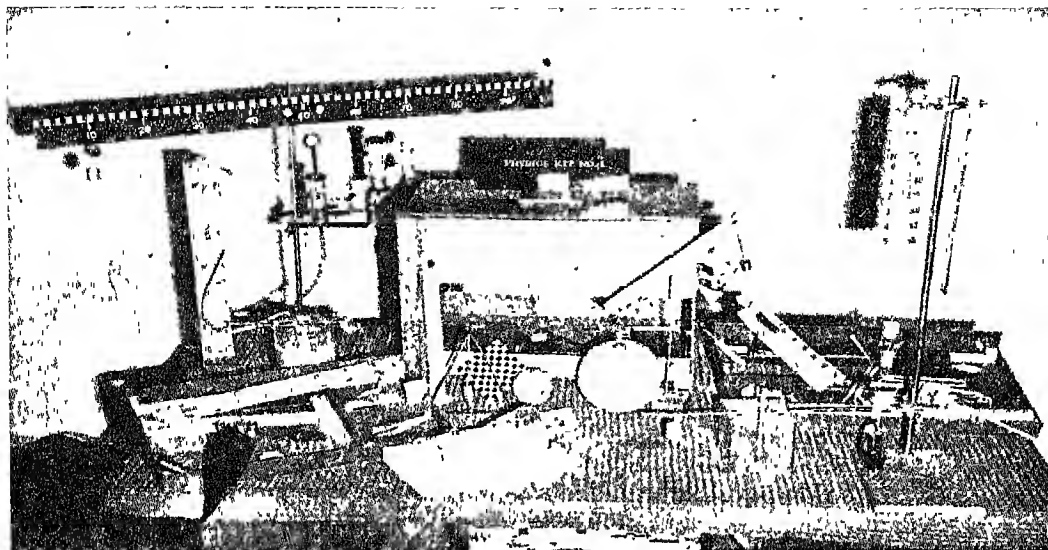
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CHAPTER 10 : HUMAN BODY, HEALTH AND HYGIENE

- | | | |
|-----|---|--|
| 57. | What makes your skin sensitive to heat, cold and touch? | Discussion based on observations |
| 58. | How do different organs of the body work together? | A chart showing the brain and spinal cord in man |
| 59. | How do sensory nerves function? | A piece of cloth for blind-folding and a corn |
| 60. | How do sensory nerves in your tongue function? | Piece of cloth for blind-folding, some crystals of sugar |
| 61. | How do you hear? | A chart showing the parts of human ear |
| 62. | How do sensory nerves and motor nerves work together? | A jig-saw puzzle |
| 63. | How do we take care of our eyes? | A torch |
| 64. | How do we protect the eyes from disease and injury? | Charts or pictures showing people suffering from eye diseases and injuries |
| 65. | What protects the brain, eyes, ears and nose from injury? | The skull of a dog, cat or other mammal |
| 66. | How is the spinal cord protected from injury? | A chart showing the structure of the spinal cord and backbone |
| 67. | How do we move our limbs and joints? | Discussion based on observations |
| 68. | How do the muscles help your arms and legs to move? | do |

PHYSICS DEMONSTRATION KIT NO. I

D.S.E. (C S W) II



The new 3-year middle school science course has been designed as separate disciplines of physics, chemistry and biology. Physics is introduced in the first year of the middle school along with biology. Chemistry is to be taken up from the second year. Physics being a major subject, a kit for each of the three classes of middle school has been developed. Beside these, there is pupil's kit for each class.

Physics Demonstration Kit No. I has been developed for the first year of the middle school. This is a complete laboratory in a wooden box measuring $530 \times 290 \times 365$ mm. consisting of several trays. In general, each tray contains improvised apparatus on a particular topic, yet it is not strictly possible, due to the limited number of trays and multi-purpose use of a particular item. The kit also contains consumable material which will suffice for at least one year and after that it

can be replenished for a small amount of money.

The kit comprises 86 different items including the kit box. Most of the items have been improvised, although a few consist of direct purchased material. Attempts have been made to utilize the same item in different situations, instead of duplicating it. Similarly, it is taken for granted that the schools will also have a primary science kit which contains hand tools. So, no hand tools have been included.

Although the kit is meant for demonstration purpose by teachers, the pupils can also perform experiments by supplementing with a few items. Under ideal conditions, however, this kit should always be supplemented with the Physics Pupils's kit No. I to form a comprehensive physics laboratory for the first year of the middle school. The kits do not create any storage problem.

The kit guide for this kit is more detailed. It contains the list of items of kit and a list of suggested demonstrations/pupil experiment topic-wise, indicating use of particular items. It also contains sketches, lists of parts and use of the particular items for explaining different concepts.

Reference books published (NCERT)

(a) Textbook

Physics, Part I, Science for Middle Schools (Revised ed. 1970)

(b) Teacher's Guide for the above textbook

(c) Kit Guide

Scientific Topics covered under the New Curriculum

- (i) Introduction to Physics
- (ii) Measurement.
- (iii) Force, weight and Pressure.
- (iv) Structure of substances.
- (v) Some properties of solids, liquids and gases
- (vi) Pressure in fluids.

List of items

- P-1. Metre scale-cum-level (bevelled), scale division 1 cm.
- P-2. 30 cm. ruler-cum-level, scale division 1 mm
- P-3. Tailor's measuring tape, scale division 1 mm.
- P-4. (i) Rubber balls, dia. 80 mm. (pair)
(ii) Rubber balls, dia. 50 mm (pair)
- P-5. 30 cm Plastic scale (bevelled)
- P-6. Right-angled triangular sheet
- P-7. Hollow sphere
- P-9. Graph paper (metric), 100 cms \times 70 cms.
- P-10. Regular figure (circle)
- P-11. Irregular figure (human foot impression)
- P-12. Support
- P-13. Unit cu. cm. block (25 Pcs.)
- P-14. Hollow unit cu. dm. vessel (transparent)
- P-15. Unit cu. cm. spoon
- P-16. Measuring cylinder, 500 ml.
- P-17. Measuring cylinder, 100 ml
- P-18. Wooden block cum test tube stand
- P-19. Dropper
- P-20. Foot ball bladder (No. 2 size)
- P-21. Rubber strip, $100 \times 50 \times 10$ mm.
- P-22. Rubber strip, $100 \times 20 \times 1$ mm
- P-23. Rubber bands (25 Pcs.)
- P-24. Compression-cum-extension spring having a free length of 100 mm. coil dia. 30 mm, material spring wire of 1 mm. dia
- P-25. Extension spring having a free length of 100 mm., coil diameter 15 mm, material-spring steel wire of 1 mm. dia.
- P-26. Spring balance (open type), range 0-500 g. wt. (pair)
- P-27. Spring balance (pupil's) range 0-100 g. wt. (pair)
- P-28. Set of five weights, each of 100 g.
- P-29. Simple level
- P-30. Device to show dependence of pressure on area
- P-31. Steel strip, $300 \times 20 \times 1$ mm
- P-32. Aluminum strip, $300 \times 20 \times 1$ mm.
- P-33. Coil having a free length of 100 mm., coil dia. 30 mm, material-Aluminum wire of 1 mm dia
- P-34. Magnets (pair)
- P-35. Set of 15 discs, dia. of each-40 mm (for explaining the elastic and plastic deformations)
- P-36. Set of 25 marbles
- P-37. Flame for marbles of P-36
- P-38. Lead cylinders (pair)
- P-39. Device for cleaning face of lead cylinders
- P-40. Mercury drop in sealed transport tube
- P-41. Drawing pins (10 Pcs.)
- P-42. Cylinder with holes
- P-43. Rod for expansion of solids
- P-45. Pointer for expansion of solids
- P-46. Bimetallic strip
- P-47. Rubber stopper with narrow bore tube (to be fitted to test tube)
- P-48. Pinch Cock (2 Pcs.)
- P-49. Thermometer, laboratory type
- P-50. Football pump
- P-51. Rubber stopper with tubes for demonstration of Pascal's law
- P-52. Pascal's ball
- P-53. Pair of interconnected tubes
- P-54. Model of spirit level
- P-55. U-Tube for manometer
- P-56. Manometer stand
- P-57. Scale for manometer and model of thermometer
- P-58. Strip for model of Celsius scale
- P-59. Model showing deflection under internal pressure
- P-60. Inter connected vessels of different shapes
- P-61. Wide transparent tube (internal dia. 36 mm \times 250 mm long) with piston
- P-62. Device for pressure in liquids
- P-63. Rubber suckers
 - (a) Large with handle (pair)
 - (b) Small with handle (pair)

- P-65. (i) Plastic bag 500 ml. capacity
(ii) Plastic bag 150 ml. capacity
- P-66. Metal sheet unit sq dm. graduated into sq cm.
- P-67. Metal sheet box with small hole made from unit sq dm sheet
- P-68. Cork for floatation
- P-69. Set of similar cylinders, made of different substances viz M S aluminium, brass and lead
- P-70. Set of cylinders, each having the same mass and diameter, made of different substances viz M S aluminium, brass and lead
- P-71. Magnifying glass (5x)
- P-72. Test tube (pair)
- P-73. Beaker-*cum*-overflow can

- P-74. Conical flask, 500 ml
- P-75. Wooden Wedge (3 Pcs.)
- P-76. Small bottle
- P-77. Laboratory lamp
- P-78. Paper clips (20 Pcs)
- P-79. Laboratory stand
- P-80. Laboratory stand clamps (2 Pcs)
- P-81. Plasticine, 50 gms
- P-82. Match box (1 Pc)
- P-83. Rubber balloons, large and medium size (6 Pcs)
- P-84. Large candles (2 Pcs)
- P-85. Cello tape (2 roll)
- P-86. Standard box
- NB P-8, P-44 and P-64 have since been omitted

Examples of Improvisation

6 HOLLOW DECIMETRE CUBE (P-14)



Requirements

- (i) To serve as an educational one-litre measure for liquid capacity and unit decimetre cube for volume measurements.

- (ii) To have 10 equal graduations marked on one of its faces.
- (iii) To serve as a transparent vessel.
- (iv) To be durable and sturdy enough to stand rough handling.
- (v) Should not be costly

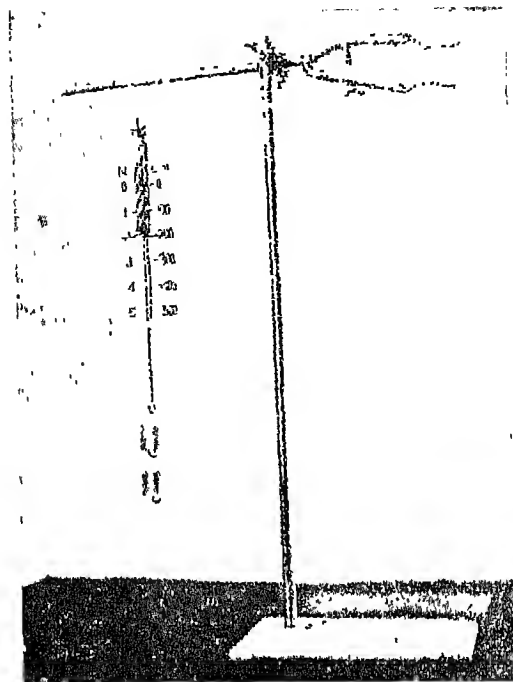
Uses

- (i) To impart ideas of unit decimetre cube volume and one litre capacity to the class.
- (ii) To obtain 1 kg. weight of water.
- (iii) As a transparent vessel for use in various teacher demonstration experiments on floatation and pressure in liquids.
- (iv) As a block for support for various experiments, especially, in the case of demonstration of a thermal expansion of solids.

The Prototype

The prototype satisfies all the requirements. Made of polystyrene, it is transparent and sturdy. There are ten equal graduations marked on one of its faces. It can contain one litre of water. It can be put to multipurpose use and is quite inexpensive.

7. SPRING BALANCE (OPEN TYPE) (P-26)



Requirements

- (i) Suitable for use in teacher demonstration experiments.
- (ii) Designed to expose its construction.
- (iii) To be durable and sturdy.
- (iv) With scale having graduations in Newton and gramweight units.
- (v) With accuracy of 5 per cent to measure forces in the range 0 to 500 g. wt. with least count of 10 gms.
- (vi) Pair of identical spring balances.
- (vii) Should not be costly.
- (ii) For measuring forces involved in various teacher demonstration experiments such as pulling.
- (iii) For demonstrating law of composition of forces (using a pan).
- (iv) For studying Archimedes Principle (using a pair)

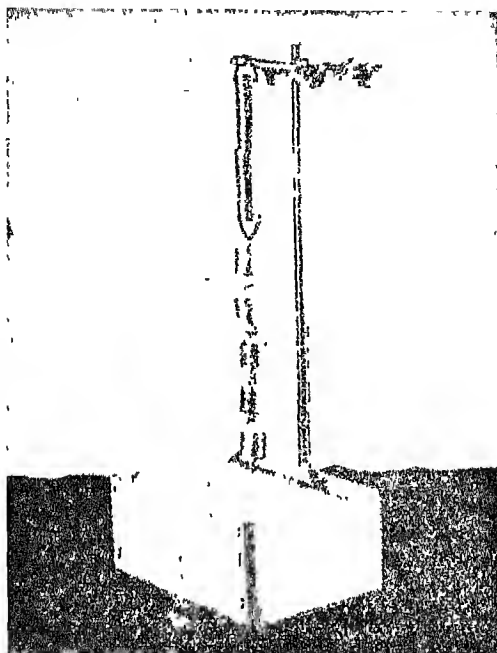
The Prototype

The prototype is simple, sturdy and open model of a spring balance to measure 0—500 gm. wt. There are ten graduations which are easily visible from a distance of six metres. These graduations are both in Newton and gm. wt. The frame is made of polythylene which is durable. It does not have any complicated component.

Uses

- (i) For explaining construction and principle of working of a spring balance.

8. LEAD CYLINDERS (P-38)



Requirements

- (i) To enable the demonstration of molecular forces of attraction (cohesion).
- (ii) Size, shape, and design of two pieces of pure lead and a cutter to facilitate teacher demonstration.
- (iii) The cutter to be efficient, durable and sturdy.
- (iv) The pair should be made of similar pieces of lead provided with suitable hooks.
- (v) Should not be costly.

Uses

- (i) For showing the effect of molecular

forces of attraction in a solid substance (lead).

- (ii) For use as a pair of spare loads.

The Prototype

The prototype consists of a pair of cylinders which are made of mild steel and lead. The lead portion is towards the tip and the mild steel portion is towards the hooks for hanging the cylinders. These cylinders are cadmium plated so that each one looks as if made of one metal only. This is very effective in use.

Caution : Tip of each cylinder should be cleaned by the special device provided in the kit box separately, before these are pressed together and hung.

9. PASCAL'S BALL (P-52)



Requirements

- (i) A device to show Pascal's law that the liquids exert pressure equally in all directions.
- (ii) Easy to handle and eliminate the use of force pump.
- (iii) To be inexpensive and durable.

Availability

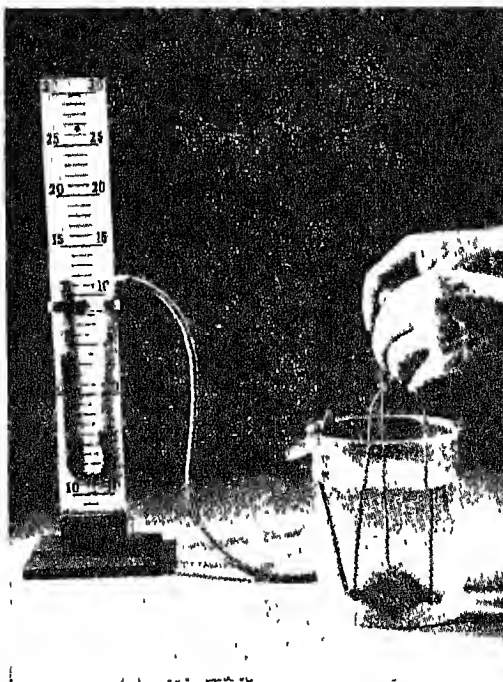
Conventional apparatus available but expensive.

The Prototype

A rubber ball of 80 mm. dia. has been provided with four small side holes and one big hole at the top. The ball is held by hand and water is filled through the big hole at the top. After that the big hole is closed by the thumb and the ball is squeezed. It will be observed that water sprays out in all directions with the same pressure.

The cost is almost negligible. The device is easy to handle and durable.

10. DEVICE FOR PRESSURE IN LIQUIDS (P-62)

**Requirements**

- (i) A device to indicate that the pressure in liquids from all directions at the same depth remains constant.
- (ii) Suitable to be fixed on the laboratory stand for demonstration.
- (iii) To be easy to handle, inexpensive and durable.

Availability

No such apparatus available

The Prototype

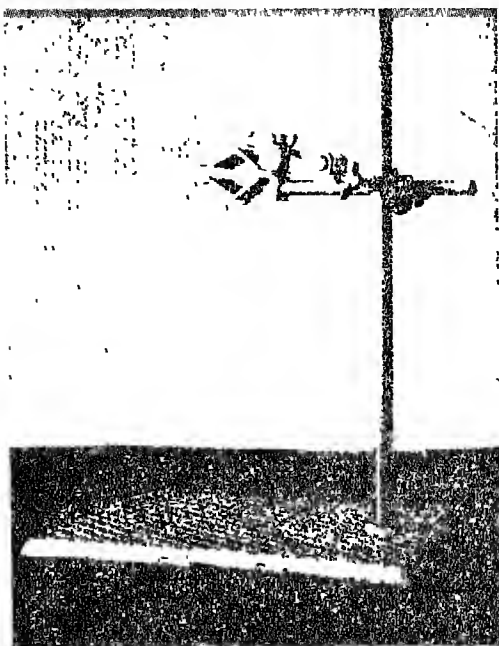
A small cup-shaped plastic vessel is provided with a fine rubber diaphragm on the

top. This vessel can rotate around a horizontal axis at the level of the rubber diaphragm with the help of a lever. The vessel is mounted on a frame which can be fixed to the laboratory stand. The vessel has a hole which is connected to a manometer by means of a rubber tube.

The vessel is placed inside a plastic beaker. The level of water in the manometer is noted. The vessel is then put in three different positions firstly, diaphragm on top, secondly, diaphragm vertical and then the diaphragm at the bottom. The water level in the manometer will remain constant.

The device is simple, inexpensive and durable.

11. LABORATORY STAND (P-79 & 80)



Requirements

- (i) To serve as a raised support and also as a stand for various teacher-demonstration experiments
- (ii) Its clamp to have a long rod so that when needed the other side could be used as a support.
- (iii) Its rod to be made up of two pieces to suit its packing in the kit; the two pieces could be screwed up or unscrewed easily.
- (iv) Should have a heavy detachable base.
- (v) Should be durable and sturdy enough to stand rough handling.
- (vi) Should not be costly.
- (ii) As a special body for demonstrating some characteristics of force.
- (iii) Its rod to have threading in common with that of the piston of the hollow plastic tube, when used as a handle of this piston.
- (iv) Piece of the handle to be used as spare cylindrical metallic-bodies

The Prototype

The Prototype was designed keeping in mind its universal use and limitation in despatch. As it forms one of the items of several kits, it was to be placed inside the kit box. A heavy cast iron base is provided containing screwed hole where rod of the stand can be fixed up. This rod has been made in two parts—one can be screwed on to the other while using. The two parts can be easily accommodated inside any of the kit boxes.

Uses

- (i) As a stand and a support in various teacher demonstration experiments.

LIST OF SUGGESTED DEMONSTRATIONS—EXPERIMENT WITH THE ITEMS OF EQUIPMENT FROM THE PHYSICS KIT INDICATED AGAINST EACH

<i>Description of Experiment</i>	<i>Items to be used from the Kit</i>
I INTRODUCTION TO PHYSICS	
I-1. Solid, liquid and gaseous substances commonly available	p-1, p-20, p-21, p-70, p-73, p-83
I-2. Simple physical properties of some bodies. (elastic/plastic, transparent/opaque, light/heavy)	p-14, p-18, p-22, p-24, p-32, p-69, p-81
I-3. Some physical phenomena (falling of bodies, floatation of bodies and formation of shadows)	p-13, p-18, p-66, p-67, p-70, p-73
I-4. Some common appliances based on principles of physics (spirit level, magnifying glass, hand torch and some working models)	p-46, p-49, p-54, p-71
II MEASUREMENT OF LENGTH, AREA AND VOLUME	
II-1. Model of metre scale with dm., cm, and mm markings	p-1, p-43, p-79, p-80
II-2. Correct measurement of length and the errors due to incorrect placement of scale	p-1, p-2, p-3, p-5, p-86
II-3. Errors in measurement due to parallax and the method to avoid them	p-1, p-31, p-32, p-56, p-79, p-80, p-81
II-4. Use of bevel scale	p-1, p-2, p-5, p-14, p-18
II-5. Use of blocks and scale for measuring diameter of round bodies etc	p-2, p-4, p-5, p-7, p-14, p-18, p-61
II-6. Use of measuring tape	p-3, p-73
II-7. Use of thread for measuring curved lengths	p-2, p-41 and inelastic thread
II-8. Models of unit sq m, sq dm, sq cm, and sq. mm surface areas	p-9, p-13, p-66
II-9. Measuring rectangular surface area by using graph papers and comparing it with its area calculated by measuring the linear dimensions	p-2, p-9, p-18
II-10. Use of graph paper for measuring surface area	p-9, p-10, p-11
II-11. Model of unit cu cm, cu dm, volumes	p-13, p-14, p-15
II-12. (a) Model of unit litre and millilitre in the form of a cu dm, and cu. cm (b) Some measuring cans and measuring vessels	p-14, p-15, p-73 p-14, p-16, p-17, p-73
II-13. Graduating measuring vessels	p-15, p-16, p-17, p-19, p-72, p-73, p-85
II-14. Use of measuring vessel for determining the capacity of a bottle	p-16, p-17, p-73, p-76
II-15. Use of a measuring vessel for determining the volume of a solid body	p-16, p-17, p-28, p-73
II-16. Use of an overflow can for determining the volume of a large solid body	p-4, p-16, p-73

III. FORCE, THRUST AND PRESSURE

- | | |
|--|---|
| III-1. (a) Effects produced by muscular force on bodies (change of state of motion of a body and its direction, and deformation of a body, | p-4, p-21, p-22, p-24, p-81 |
| (b) Interaction between two bodies as the action of force | p-4, p-14, p-24, p-28, p-79 |
| III-2 Effects produced by other forces | p-4, p-14, p-18, p-34, p-61, p-68, p-79, p-80, p-86 |
| (i) Mechanical, (ii) Gravitational, | (only one shelf) |
| (iii) Electrical and (iv) Magnetic | |
| III-3. Extensions produced in a spring by different forces (of different magnitudes) acting on it | p-24, p-25, p-28, p-79, p-80 |
| III-4. Principle of graduating a spring balance | p-26, p-28, p-79, p-80, p-85 |
| III-5 Effect of magnitude, direction and point of application of a force acting on the body | p-23, p-26, p-61 |
| III-6. Vertical direction and plumb-line | p-28, p-29, p-79, p-80, p-82 |
| III-7. Composition of the two forces acting in the same line | p-23, p-26 (para), p-41, p-86 (only one shelf) |
| III-8. Examples of thrust and pressure | p-49, p-79 |
| III-9. Dependence of pressure on | p-28, p-30, p-86 (only one shelf) |
| (i) Thrust and | |
| (ii) Supporting area | |

IV MOLECULAR STRUCTURE OF SUBSTANCES

- | | |
|---|---|
| IV-1 Grinding of crystals of sugar | Borrow pestle and Mortar and sugar |
| IV-2 Dissolving powdered sugar in water | p-14, p-15, p-43, p-71 and p-73 |
| IV-3 Observing minute objects under a microscope or a magnifying lens | p-71, borrow microscope from Biology stores |
| IV-4. (i) Change of volume on dissolving salt in water, and | p-23, p-36, p-47 p-72, p-73, p-79, p-80 |
| (ii) Its explanation on the basis of molecular model | |
| IV-5. Interaction between two lead cylinders (molecular cohesion) | p-28, p-38, p-39, p-79, p-80 |
| IV-6. Cohesion between drops of water | p-14, p-24, p-43, p-67, p-73, p-79, p-80, p-81, p-85 |
| IV-7. Shape of mercury drops | p-40, p-71 |
| IV-8. Mechanical model of molecular interaction | p-41, (ii), p-25 |
| IV-9. Forces required to tear apart sheets of paper of different sizes | Some strips of papers of different sizes and thickness |
| IV-10 Diffusion | p-47, p-73, p-74 |
| IV-11. Principle for marking fixed points on a thermometer | p-49, p-73, p-77, or p-84, ice, p-79, p-80 |
| IV-12. Use of thermometer for measuring temperatures. | p-49, p-72, p-73, p-77 or p-84 |
| IV-13. Taking readings on the model of celsius scale | p-56, p-57, p-58 |
| IV-14. Expansion of solids on heating | p-14, p-28, p-43, p-45, p-77, or p-84, p-80, p-79, p-82 |
| IV-15. Expansion of liquids on heating | p-18, p-23, p-72, p-73, p-77 or p-84, p-82 |
| IV-16. Expansion of gases on heating | p-47, p-72, p-77 or p-84, p-82 |
| IV-17. Bimetallic strip and its use | p-46, p-77, or p-84, p-79, p-80, p-82 |
| IV-18. Model of molecular structure of solid, liquid and gaseous forms of a substance | p-36, p-37 |

V. SOME PROPERTIES OF SOLIDS AND FLUIDS

V-1. Elastic deformation	p-4, p-20, p-21, p-22, p-25, p-28, p-31, p-32, p-33, p-35, p-79, p-80, p-81
V-2. Plastic deformation	p-32, p-79, p-80, p-81
V-3. Molecular model of elastic and plastic deformation	p-35, p-36, p-37, tray of p-86
V-4. Breaking a brittle body	Dry wooden stick (p-82) of Glass plate/tube
V-5. Increase of plasticity of a steel wire by heating	p-77, or p-84, p-79, p-82 steel wire
V-6. Change of gas pressure with change of volume	p-23, p-61, p-83, rod of p-79
V-7. Increase of gas pressure with increase of temperature	Cleaned empty tin with lid, p-77, p-79 and p-80, p-82
V-8. Surface of liquids at rest and its relation with vertical direction	p-6, p-14 or p-73, p-79, p-80
V-9. Construction and use of a simple level	p-29
V-10. Construction and use of a spirit level	p-54
V-11. Interconnected vessels	p-48, p-53, p-79, p-80
V-12. Pascals' law for fluids (i) qualitative idea (ii) quantitative idea	p-50, p-51, p-52, p-74
V-13. Model of hydraulic press	
V-14. Working of an pump	p-20, p-50, p-83

VI. PRESSURE IN FLUIDS

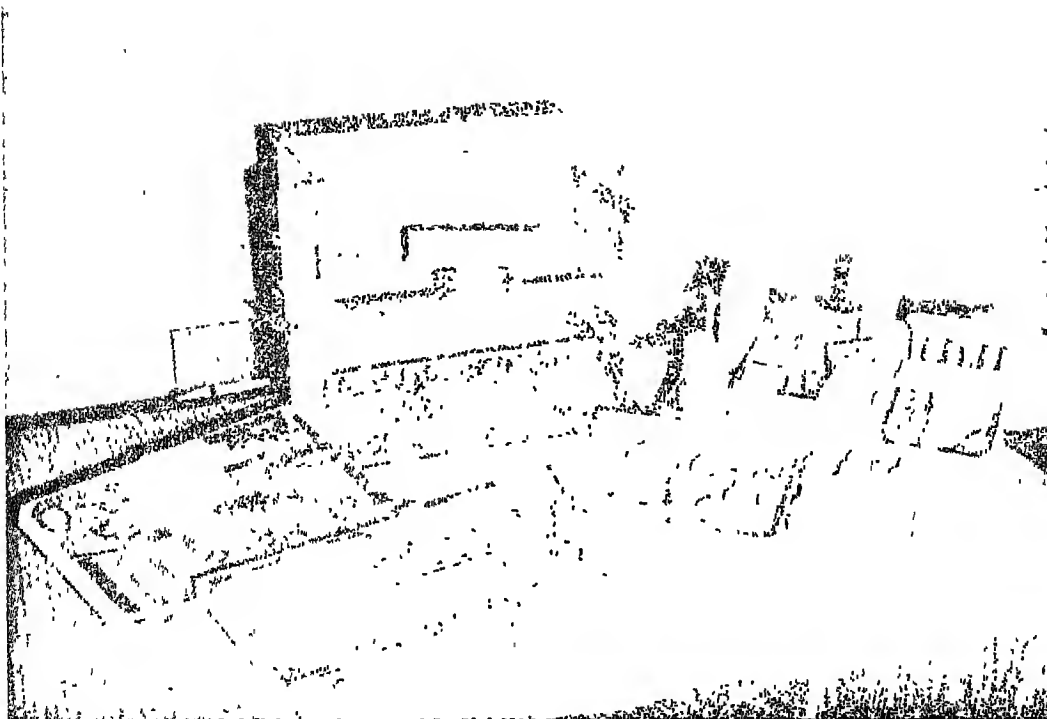
VI-1. Pressure on the base supporting the liquid and its increase with the increasing height of liquid column	p-23 p-61, p-73, p-83 or p-14
VI-2. Pressure at different depths and inside the liquid	p-8, p-55, p-56, p-72, p-73, p-79, p-85, p-72 (Rubber tubing)
VI-3. Pressure on the wall of a vessel	p-42
VI-4. Existence of atmospheric pressure	p-41, p-63
VI-5. Rising of water due to the atmospheric pressure	p-19, p-73
VI-6. Idea about the magnitude of atmospheric pressure with the help of a rubber sucker	p-14, p-28, p-63
VI-7. Working of a water pump	p-12, p-18
VI-8. Air has weight	p-2, p-7, p-20, p-50, p-78, p-79, p-80
VI-9. Measuring magnitude of the buoyant force	p-18, p-26, p-73 or (p-14) a stone pipe
VI-10. Archimedes' Principle for partly and fully immersed bodies	p-17, p-26, p-65, p-70, p-73, p-78, p-79, p-80
VI-11. Dependence of buoyant force on the volume of the body	p-26, p-69, p-70, p-73, p-79, p-80
VI-12. Dependence of buoyant force on the relative weight of the liquid.	p-14, p-16, p-26, p-69, p-79, p-80
VI-13. Floatation of bodies of different substances in a liquid	p-18, p-68, p-72, p-73
VI-14. Floatation of a body in different liquid	p-18, p-68, p-72, p-73
VI-15. Demonstration to explain floatation of ship	p-66, p-67, p-73, p-81

PUPIL EXPERIMENTS

1. (a) Measuring linear dimensions of a rectangular block p-5, p-18

- | | |
|---|--|
| (b) Measuring average thickness of book sheets, or the average diameter of a wire or thread | p-5, p-72 |
| 2. Measuring surface area by using graph paper | p-9, p-10, p-11 |
| 3 (a) Measuring volume of an irregular small solid using a graduated test tube or cylinder | p-15, p-17, p-72, p-73, p-85 |
| (b) Measuring the average volume of water, using a dropper | p-19 (plus item against 3 a) |
| 4 Making a simple spring balance by graduating a spring and using it for measuring the weight of a body | p-12, p-15, p-18, p-27, p-28, p-65, p-73 |
| 5. Studying the expansion of a liquid on heating | p-18, p-47, p-72, p-82, p-84 |
| 6 Use of spring and coils for a simple study of plasticity and elasticity | p-9, p-24, p-28, p-33 p-79, p-80 |
| 7. Vertical direction and level surface | p-29, p-54 |
| 8. Study of Archimedes' Principle | p-26 p-65, p-70, p-73, p-78, p-79, p-80 |
| 9 A study of the conditions of floatation | p-9, p-72, p-73, p-85 |

PHYSICS PUPIL'S KIT NO. I
D.S.E. (C.S.W.) III



This kit provides material for pupil's experiments. It consists of a wooden kit box measuring $480 \times 255 \times 430$ mm. with five trays of different sizes. There are twenty-five items but in varying quantities. The list of items specifies contents of each of these trays so that after the experiment pupils can themselves put these items back in their places. The kit is meant for a class of 44 pupils who will form groups of two each to perform the experiments.

Necessarily, items of this kit have been selected from the list of items of the Physics

Demonstration Kit No. 1. Most of these items are available in the local markets so that there will not be any difficulty in providing replacements. This kit also eliminates storage problem as it can be locked and kept in a corner of the room.

Since this kit is only a supplement to Physics Demonstration Kit No. 1, the books published and list of topics covered are the same. A few examples of improvisation of apparatus are, however, given after the list of items.

List of Items*Tray No. 1*

- | | |
|---|----|
| 1. Test tube support (Polythene, for 12 test tubes) | 2 |
| 2. Wooden block-cum-test tube holder | 22 |
| 3. Plastic tumbler (with a pouring beak) | 22 |

Tray No. 2

- | | |
|--|-----------|
| 4. Graph paper (metric, 10 cms —20 cms.) | 22 sheets |
| 5. Rubber band (big) | 44 |
| 6. Rubber band (small) | 44 |
| 7. Toy balloons (small) | 88 |
| 8. Polythene bags (100—200) | 22 |
| 9. Glass marbles (10 mm dia.) | 132 |
| 10. Cellotape (small) | 1 reel |
| 11. Drawing pins (steel plated) | 144 |
| 12. Paper clips | 100 |
| 13. Plasticine | 100 |

Tray No. 3

- | | |
|--|----|
| 14. Bottle (polythene) | 22 |
| 15. Polythene tube (transparent, 4 mm. bore×30 cm. long) | 22 |
| 16. Polythene tube (transparent, 5 mm bore×10 cm long) | 22 |
| 17. Polythene tube in No. 2 cork (transparent, 3.5 mm. bore×15 cm. long) | 22 |
| 18. Rubber suckers (small) | 22 |

Tray No. 4

- | | |
|--------------------------------------|----|
| 19. Spring balance (Pupils) | 22 |
| 20. Compression-cum-extension spring | 6 |
| 21. Wooden wedge small | 66 |

Tray No. 5

- | | |
|-------------------------|--------|
| 22. Candles | 22 |
| 23. Match Box | 1 doz. |
| 24. Plastic bevel scale | 22 |
| 25. Dropper (polythene) | |

The Kit Box

Examples of Improvisation

12. SPRING BALANCE (PUPILS) RANGE 0-100 G. WT. (PAIR) (P-27)

Requirements

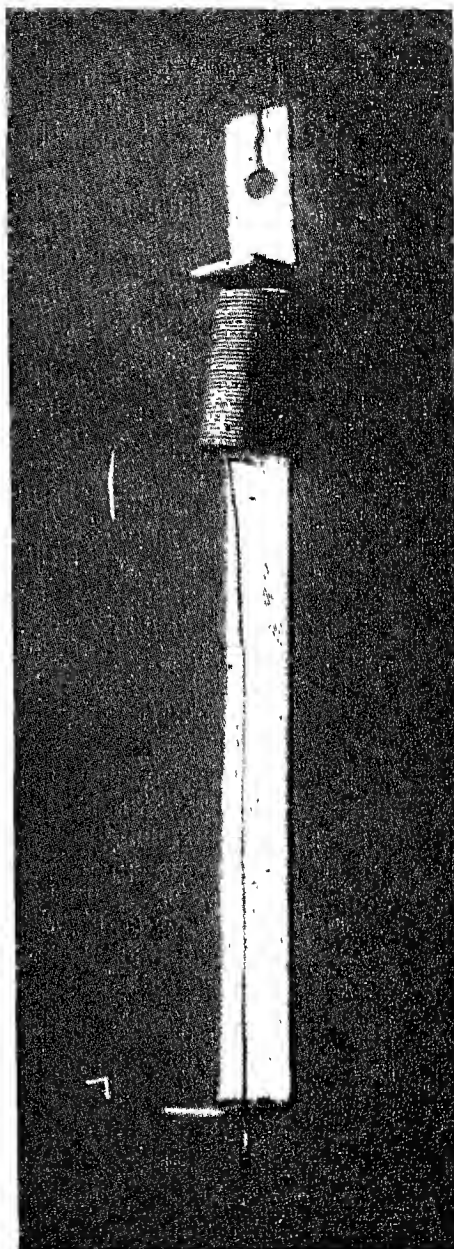
- (i) A simple device for measurement
- (ii) Ungraduated
- (iii) Inexpensive.

Concepts and Skills

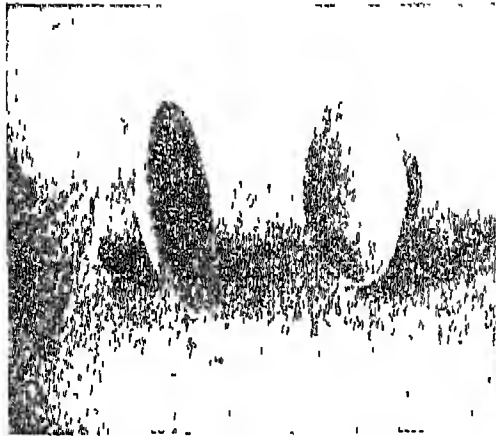
- (i) Measurement.
- (ii) Calibration.

The Prototype

The prototype developed fulfils the requirements. It is simple and handy so that pupils can handle without any hesitation. The body and spring are made of mild steel. The spring has been tempered so that it retains elasticity. Space has been provided below where the child can mark graduations by pasting graph paper.



13. RUBBER SUCKERS (*P-63*)



Requirements

- (i) A device which could produce vacuum conditions.
- (ii) Simple and handy.
- (iii) Lasting and inexpensive.

Uses

- (i) To illustrate Magdeburg's Hemispheres.

Concepts

- (i) Atmosphere exerts pressure

The Prototype

The prototype consists of a pair of rubber cups with handles generally used for grinding valves in the automobile industry. It is inexpensive, sturdy and simple. It provides good vacuum conditions when the two cups are pressed against each other.

PHYSICS DEMONSTRATION KIT NO. II

D.S.E (C.S.W) IV



Physics Demonstration Kit No II is meant for teaching physics to the second year class of the middle stage. Along with the Pupil's Kit No. II, it provides a complete laboratory

Most of the items consist of improvised apparatus but efforts have been made to include whatever items could possibly be purchased from the market. These items are contained in four trays provided in the kit box measuring $530 \times 290 \times 390$ mm., which facilitates their use and return. There are 71 items including the kit box. The box can be locked and stored in a corner of the class room and does not create any storage problem.

NCERT has published a textbook and teacher's guide which are supplemented by this kit for doing laboratory experiments. A

kit guide has been prepared which lists out 52 demonstrations/experiments. Here the items have been depicted according to the experiments. This will be more useful for the teacher.

Books Published (NCERT)

- (a) Textbook
Physics Part II—Science for middle school
- (b) Teacher's Guide for Physics Part II
- (c) Kit Guide

Scientific Topics covered under the New Curriculum

- (1) Mechanical motion.
- (2) Composition of Forces, Equilibrium of bodies
- (3) Work and Energy.
- (4) Thermal phenomena.
- (6) Heat and Work.
- (6) Transition of substances from one aggregate state into another.

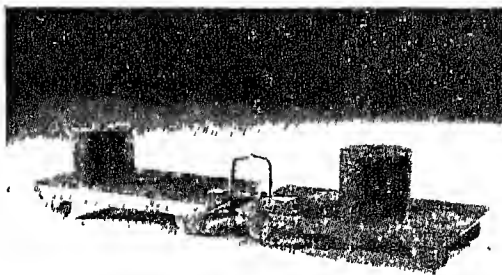
LIST OF ITEMS

<i>Sl No</i>	<i>Chapter</i>	<i>Item</i>	<i>Place in kit Tray</i>
P-101.	General	Laboratory stand with clamp and boss-head	1
P-102.	General	Hard Board sheet- <i>cum</i> -screen	1
P-103.	General	Stand for Hardboard sheet	2
P-104.	General	Paper clips (1 doz.)	1
P-105.	General	Cellotape (1 reel)	1
P-106.	1	Polythene tube with two corks and pith ball	4
P-107.	1,2,3	Flags (4 Nos)	4
P-108.	1,2,3	Trolleys (2 Nos.)	2
P-109.	1,2	Catch for trolleys	2
P-110.	1,2	Compression spring, 45 mm long for trolleys	2
P-111.	3	Bolt with fly nut for trolley	2
P-112.	3	Rod with pulley at one end for trolley	2
P-113.	3	Rubber sleeve with thread for trolley	2
P-114.	1	Curved Guide	2
P-115.	1	Steel Ball, 22 mm.	2
P-116.	1	Chalk holders (3 Nos.)	4
P-117.	1	Rubber suckers (2 Nos.)	4
P-118.	1	Clock model	2
P-119.	1,2,3	Weight 100 g. wt. (2 Nos)	4
P-120.	1,2,3	Block of wood with sand paper	2
P-121.	2,3	Roller with hook	2
P-122.	1,2	Small plastic bag	1
P-123.	2,3,5	Beam balance	4
P-124.	2,3,5	Weight box	4
P-125.	2,3	Open type spring balance (2 Nos.)	2
P-126.	2,3	Hollow cylinder	2
P-127.	2	Hammer with detachable head	2
P-128.	2	Bicycle pedal	2
P-129.	2	Bicycle wrench	2
P-130.	2	Syringe and tube	3
P-131.	2	Toy balloons (6 Nos)	1
P-132.	2,3	1 kg. weight with hook (2 Nos.)	2
P-133.	3	Meter scale- <i>cum</i> -lever	4
P-134.	3	30 cm ruler- <i>cum</i> -lever	4
P-135.	3	Support for the above ruler- <i>cum</i> -lever	4
P-136.	3	Pulley with hook (2 Nos.)	2
P-137.	3	Maxwell's wheel	2
P-138.	3	Compression spring 85 mm.	2
P-139.	4	Tuning fork	2
P-140.	4	Resonance box for tuning fork	2
P-141.	4	Striker for tuning fork	2
P-142.	1,4	Discs with teeth (2 Nos.)	4
P-143.	4	Rotator for above discs	4
P-144.	4	Metallic strip	4
P-145.	4	Sitar string	4
P-146.	4	Steel wire 5 m. long	4
P-147.	4	Small balls (Ghungru beads) on rubber tubing with pinch-cock	3
P-148.	5,6	Kerosene wick-stove	3

P-149.	5,6	Candle (2 Nos.)	3
P-150.	5,6	Match box	3
P-151	5,6	Thermometer	3
P-152	5,6	Flat bottom flask 500 c c	3
P-153	5,6	Cork with glass tube for above	3
P-154	5,6	Measuring cylinder, 100 c.c. (polythene)	3
P-155	5,6	Test tube corning (2 Nos.)	3
P-156.	5,6	Cork with polythene tube for above	3
P-157.	5,6	Outer vessel of calorimeter	3
P-158.	5,6	Inner vessel of calorimeter	3
P-159.	5,6	Seat for above inner vessel of calorimeter	3
P-160.	5	Iron rod	3
P-161.	5	Aluminium rod	3
P-162	5	Socket for above iron rod and aluminium rod	3
P-163.	5	Glass tube corning	3
P-164.	5	T-strip for above glass tube	3
P-165	5	Thermoscope	3
P-166.	5	Cork and U-tube for above thermoscope	3
P-167.	5	Set of cylinders of equal mass	3
P-168	5	Frame for above set of cylinders	3
P-169	5	Metal box for melting wax	3
P-170.	5	Wax (100 g.)	3
P-171.	—	Kit Box	

Examples of Improvisation

14. TROLLEYS (Item No. P-108)



Requirements

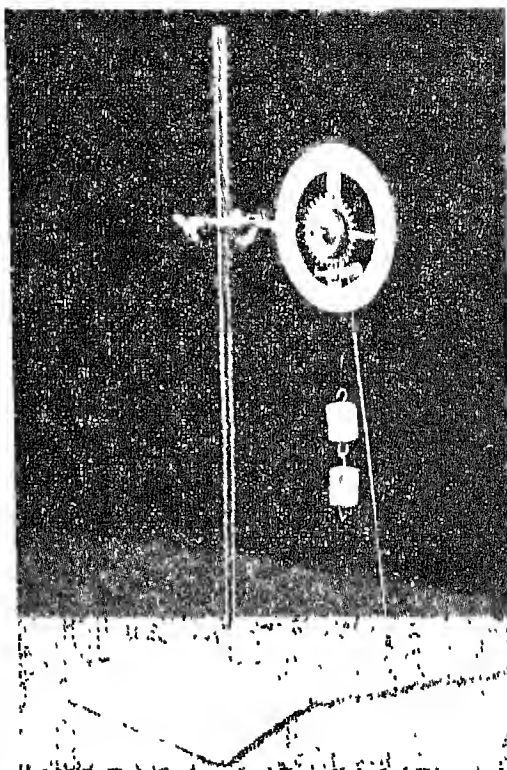
This item is for multipurpose use. It is required in a number of experiments on relativity of motion, inertia of rest, inertia of motion, comparing inertial masses of two bodies, potential energy of a lifted body, action and reaction, rotatory and translatory motions etc. According to different requirements the pair of trolleys has to be sturdy sensitive, simple and durable. It should provide frictionless motion as far as possible.

At the same time it should not be expensive.

The Prototype

The prototype developed fulfils all the requirements. If properly handled, it should last for a long time. Made out of a thin M.S. Sheet, it has spray paint coating to minimise chances of corrosion. Tapered axle bearings eliminate friction. To make it multipurpose, special shape has been given and the main body carries two holes.

15 A CLOCK MODEL (P-118)

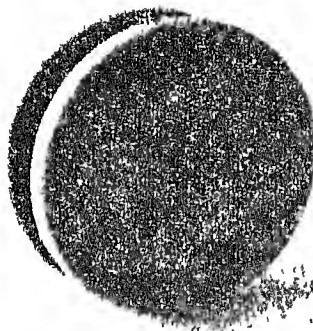
**Requirements**

- (i) A device for measuring time.
- (ii) Its working should be visible to pupils.
- (iii) Length of pendulum should be adjustable.
- (iv) Simple mechanism but of sturdy construction
- (v) Inexpensive but durable.

The Prototype

The improvised model satisfies all the requirements and is ideal for demonstration. Children can see the working of an escapement wheel. The frequency of the oscillation of the pendulum can be adjusted. The construction is simple yet every part is sturdy. On mass scale production, cost can be appreciably reduced. If handled properly, it will last long.

16. MAXWELL'S WHEEL (P-137)

**Requirements**

- (i) To improvise a substitute for the conventional Maxwell's wheel to demonstrate conversion of potential energy to kinetic energy and *vice-versa*.
- (ii) Use of a single suspending thread instead of two.
- (iii) Easy to handle, inexpensive and durable.

Availability

No such model available.

The Prototype

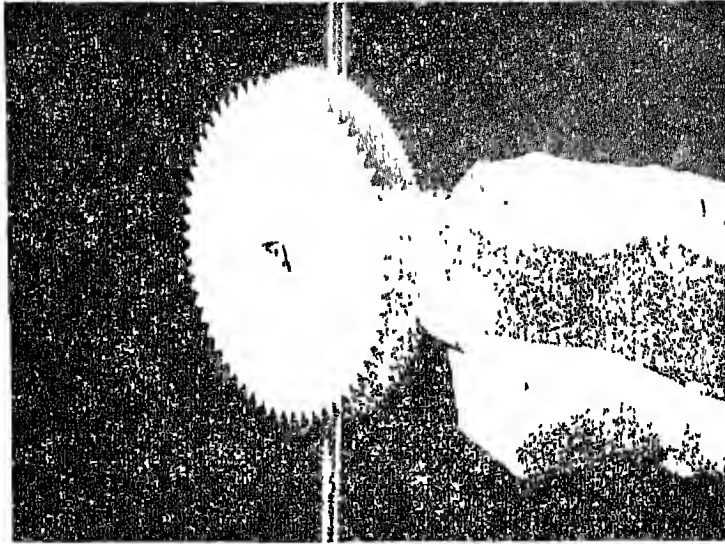
Made out of plastic, it consists of a wheel

having a deep groove at the middle. Down where the groove finishes, a hole has been provided so that one end of the thread can be made to pass through this hole and a knot tied. The other end of the thread is either held by the teacher in his hand or fixed to the laboratory stand.

The wheel is rotated so that the thread is wrapped in the groove and the wheel moves up. At the highest position of the wheel it is released. It will be noticed that the wheel continues to come up and go down for some time.

The device is simple, inexpensive and durable.

17. DISCS WITH TEETH AND ROTATOR FOR DISC AND METALLIC STRIP,
(S. No. 142, 143 and 144)



Requirements

- (i) A device to produce different frequencies of sound with the help of two discs
- (ii) To produce different sounds at the same frequency by using different materials.
- (iii) To be simple, inexpensive and durable.

Availability

Some devices available but costly.

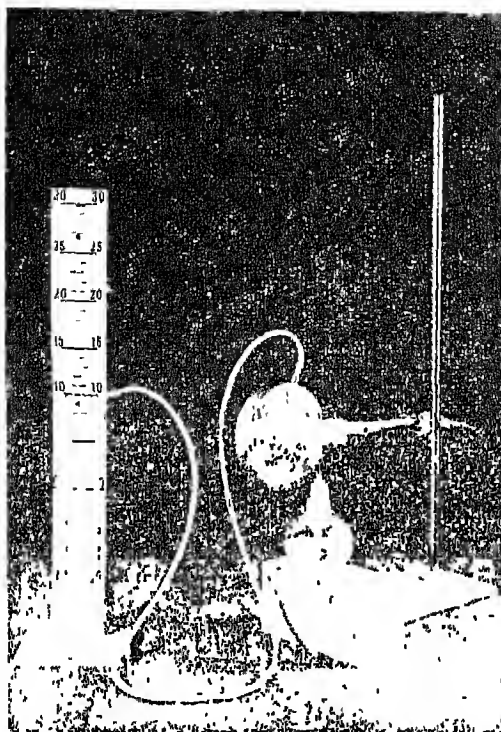
The Prototype

It consists of two discs mounted on a shaft

which could be rotated. The discs have different number of teeth, and are made of mild steel or other substances. Although a steel strip is provided, it is recommended that other strips may also be made out of different material like wood, paper, etc.

When one of the discs is rotated, the different strips are made to touch the teeth in the direction of rotation. Thus different sounds will be produced. When both the discs are rotated and their teeth are touched by the same strip, sounds of different frequencies are produced.

The device is simple, inexpensive and durable.

18. THERMOSCOPE (*P-165*)**Requirements**

A device required to illustrate thermal phenomena of conduction, radiation and internal energy. It necessitated the provision of a black surface as well as a shining white surface, a sealed container with one outlet for connecting with a manometer for demonstrating change in internal energy.

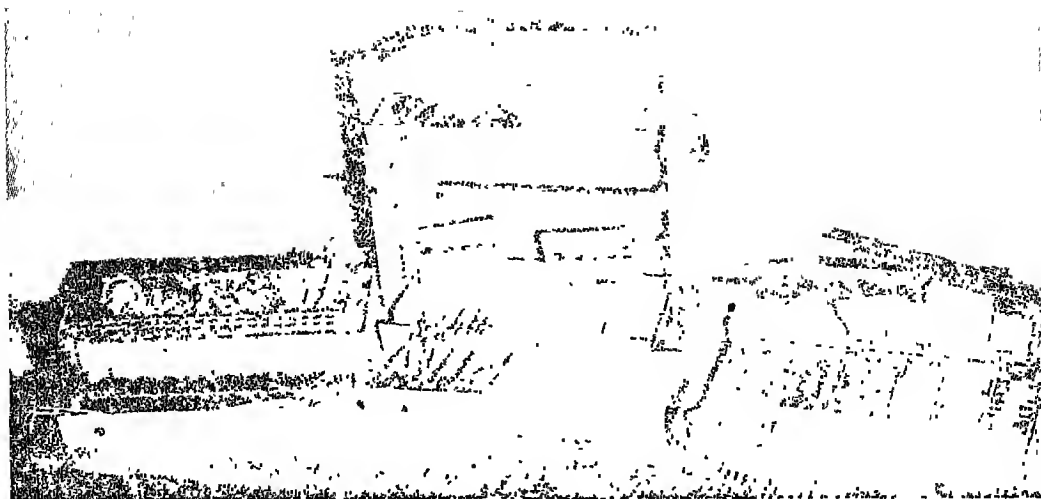
The Prototype

The prototype satisfies all requirements. The sides are made of thin brass sheet and the central separating ring of the body is of polystyrene plastic. An insulating handle is also provided. The outlet can be connected with a manometer by means of a plastic tube. This apparatus is ideal for demonstration as well as pupil's use. Concepts of radiation, conduction and change of internal energy can be easily demonstrated.

LIST OF ACTIVITIES

1. Relativity of motion
2. Rotatory Motion
3. Translatory motion
4. Oscillatory motion
5. Time period of a simple pendulum
6. Measuring time
7. Uniform motion
8. Measuring speed
9. Inertia of rest
10. Inertia of motion
11. Comparing of inertial masses of two bodies
12. Comparing mass by a beam balance
13. Use of beam balance
14. Density of a substance
15. Study of friction
16. Comparison of sliding and rolling friction
17. Action and reaction
18. Force of reaction
19. Mechanical work
20. Principle of lever
21. Work done using a lever
22. Pulleys
23. Work done using a pulley
24. Inclined plane
25. Kinetic energy
26. Dependence of kinetic energy on speed and mass of a body
27. Potential energy
28. Potential energy of a lifted body
29. Transformation of energy
30. Vibration of a sounding tuning fork
31. Dependence of sound on the extent of vibration
32. Propagation of sound through steel wire
33. Decrease of intensity of sound in stretched air
34. Relation between pitch of sound and frequency of vibration
35. Increase in internal energy due to the work performed
36. Work performed at the expense of internal energy
37. Transfer of internal energy
38. Conduction of heat in metals
39. Convection currents in air
40. Convection in chimneys
41. Convection currents in liquids
42. Heat conduction in water
43. Heat conduction in air
44. Thermal radiation
45. Measurement of the quantity of heat
46. Mixing of cold and hot water
47. Specific heat
48. Melting of crystalline substances
49. Rate of evaporation increases with open surface area
50. Cooling due to evaporation
51. Boiling
52. Boiling at reduced pressure

PHYSICS PUPIL'S KIT NO. II
DSE (CSW) V



The kit contains material for the pupil's experiments. There are 23 items excluding the kit box, mostly in multiples of 15. It is intended to provide each item for 3 students so that the kit box will cater for a class of 45 pupils. Items have been selected from the list of items of the physics Demonstration Kit No II. Thus, Demonstration Kit along with the Pupil's Kit makes a complete physics laboratory for the second year of the middle school.

The wooden kit box measures $480 \times 257 \times 530$ mm. height and has seven compartments consisting of trays which can be pulled out. Height of each tray has been designed according to the items to be kept inside. There are about 400 items in all. Again, there is no storage problem, handling is easy and replenishment of the used and unserviceable items is also within reach of even a rural school. Pupils can perform major experiments.

LIST OF ITEMS

	<i>Qty</i>
<i>Tray No. 1</i>	
1 Weight box for beam balance	15
2. Pulley with hook	15
<i>Tray No. 2</i>	
3 Two cylinders, one made of steel, another of aluminium of the same volume with narrow bore The steel one weighs 100 gms.	15 pairs
4 Flags	15
5 Steel strip ($20 \times 15 \times 200$ mm. 26 SWG), to be used as spring	15
6. Rectangular block made of wood, steel and aluminium ($40 \times 30 \times 10$ mm) for finding density	15 each
7 Small steel disc (dia. 40×2.5 thick, one face pointed).	15
8. Thermometer (-10°C — 110°C)	15

Tray No 3

- | | | |
|---|--|----|
| 9 | Beam balance (pans kept in Tray No. 7) | 15 |
|---|--|----|

Tray No. 4

- | | | |
|-----|------------------------------|----|
| 10. | 30 cm ruler-cum-lever | 15 |
| 11. | Support for ruler and pulley | 15 |
| 12. | (a) Rack for test tubes | 15 |
| | (b) Test tubes in (a) | 44 |

(15 of them are half filled with Naphthalene).

- | | | |
|-----|------------------|----|
| 13. | Test tube holder | 15 |
|-----|------------------|----|

Tray No 5

- | | | |
|----|--|------------|
| 14 | Hard board (6 mm thick×450 long) | 15 |
| 15 | Wooden blocks pair each with sand paper and hook, weights—
100 gms. | 15 |
| 16 | Sitat wire | 15 lengths |
| 17 | Adjusting piece | 15 |
| 18 | Plastic tumbler with a beak | 15 |

Tray No 6

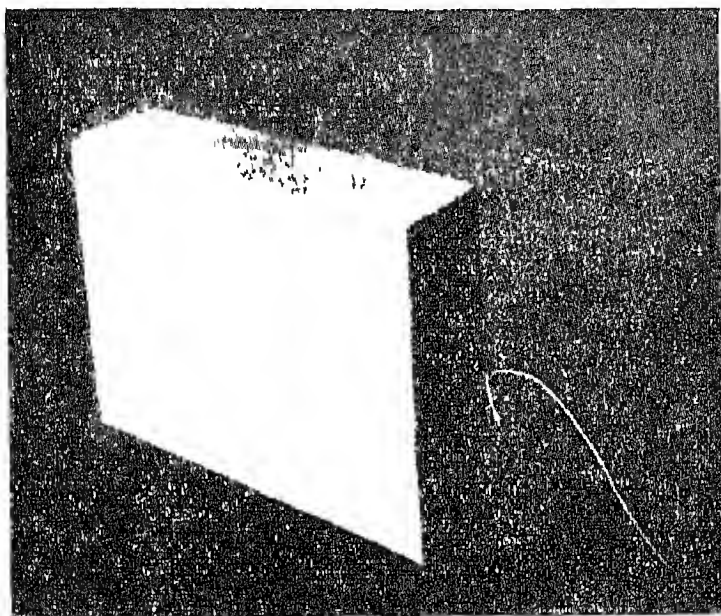
- | | | |
|-----|--|----|
| 19. | Spring balance (pupils') | 30 |
| 20. | Measuring cylinder without base (100 c.c.) | 15 |
| 21. | Plastic bag (100×200 mm) | 15 |
| 22 | Polythene tube in No. 2 cork (Transparent, 3.5 mm bore×15 cm long) | 15 |

Tray No 7

- | | | |
|-----|-----------------------------|----|
| 23. | Kerosene lamp with chimney. | 15 |
| 24. | Kit Box | 1 |

Examples of Improvisation

19. BLOCK OF WOOD WITH SAND PAPER (P-120)



Requirements

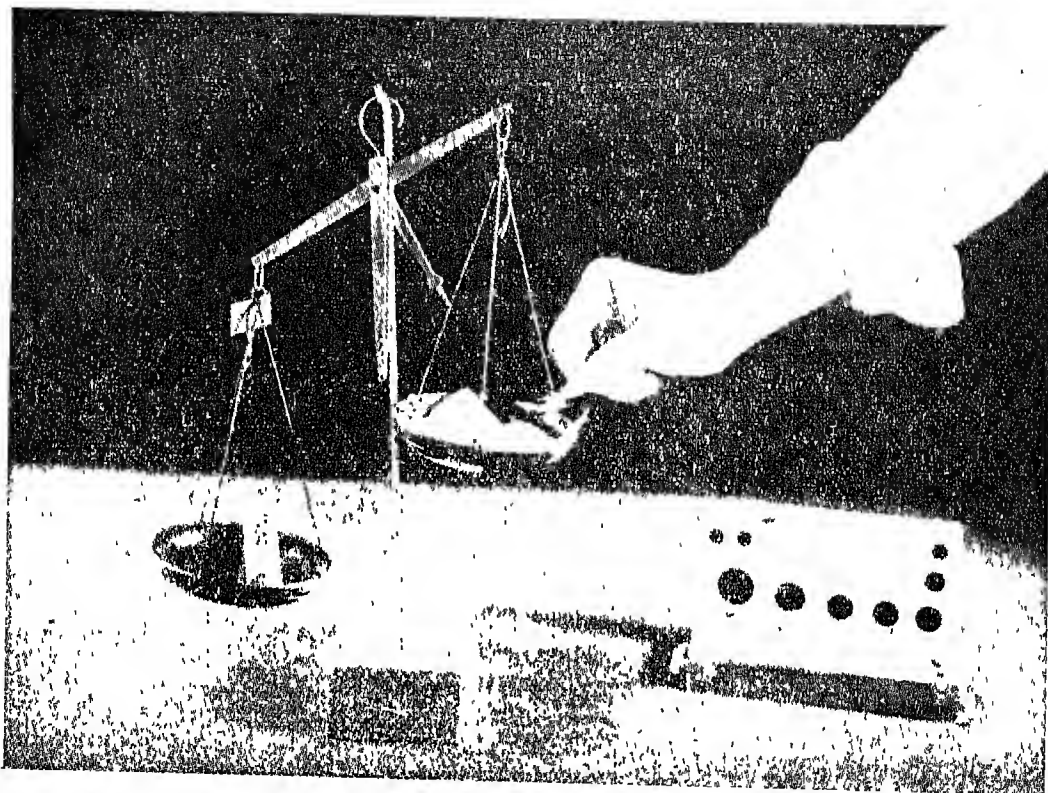
A block of wood has multipurpose uses. It is used for showing the inertia of rest and inertia of motion, the dependence of the frictional force on the nature of the surface and complete independence of the frictional force of the surface areas. It is also used as a load in several demonstrations on the kinetic and potential energies. A rough

surface was required on one of the faces.

The Prototype

The prototype fulfils all requirements. Approximately of 100 mm. \times 60 mm. size, it may have 25 mm. thickness. Made of hardwood, its plain surface is quite smooth. A piece of sand paper is pasted on two surfaces which become rough. A hook is provided for pulling. It is quite inexpensive.

20 BEAM BALANCE (P-123)

**Requirements**

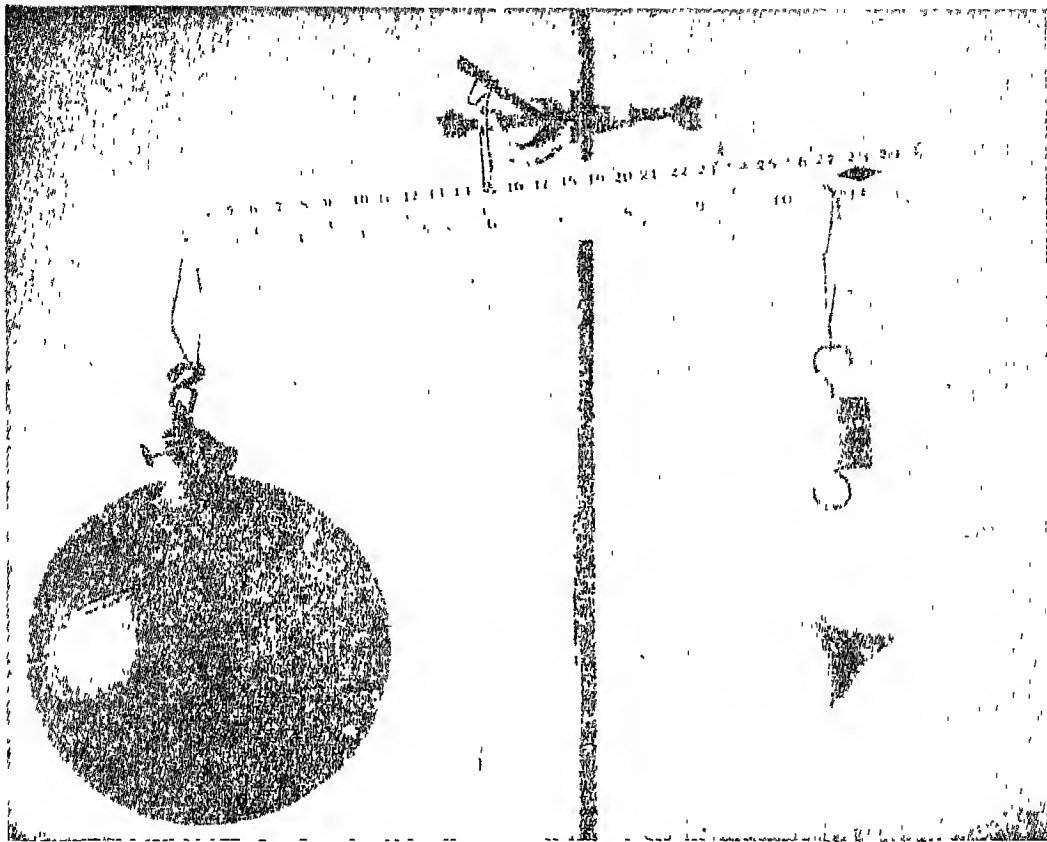
The balance is required to provide the concept of measurement of mass to the pupils. It has to be simple so that young children could handle it without any difficulty. It should be sturdy as well as economical. It is required to measure small quantities only.

The Prototype

The prototype satisfies all the requirements. The pans are made from unbreak-

able plastic. The beam, the pointer and the knife edge pivot are made of mild steel. The pans are hung by strong pieces of thread. It is advised that for initial balancing, small quantities of plasticine should be stuck on the bottom of the pans. The device is simple and effective for rough measurements that the pupils are expected to undertake. A small size weight box with standard weights is supplied along with the beam balance.

21 RULER-CUM LEVER (S No 134)

**Requirements**

- (i) A ruler to provide the measurements
- (ii) To be used as a lever
- (iii) To be simple, inexpensive and durable.

Availability

Available as a ruler only

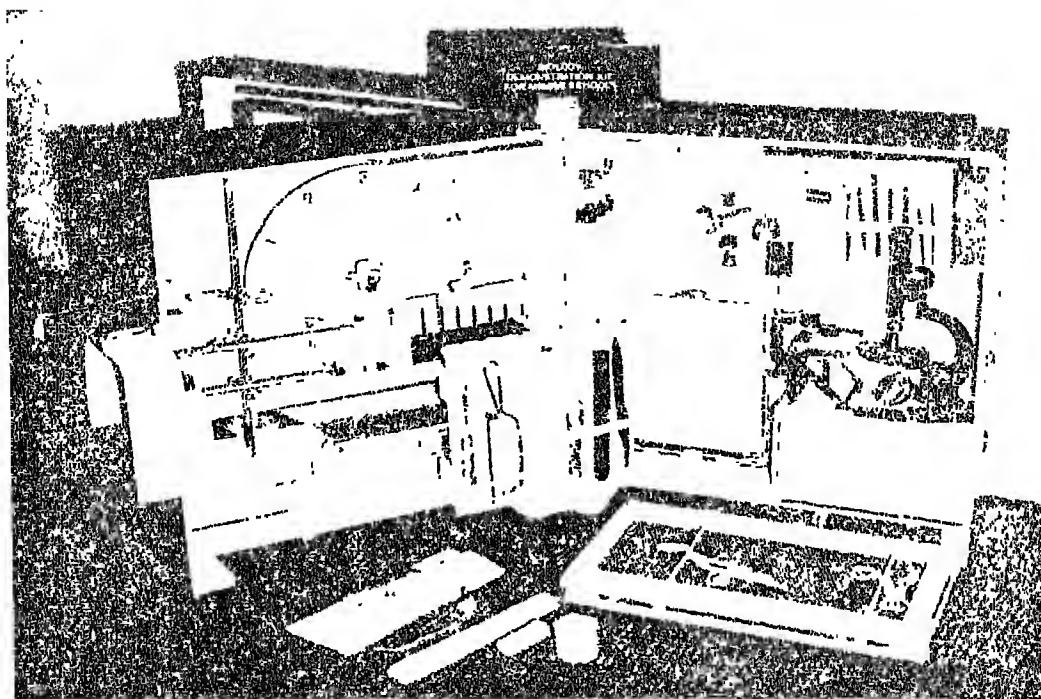
The Prototype

The prototype represents the aluminium

ruler with holes provided at the appropriate places. Holes have been made for facilitating suspension of hooks (paper clips) while using this as a lever. The lever will be in horizontal position only when the moments of forces on either side are equal. Initially to make it horizontal, a piece of plasticine may be attached to the lighter side. The lever can also be used as a beam of the simple balance.

It is simple, inexpensive and durable.

BIOLOGY DEMONSTRATION KIT FOR MIDDLE STAGE **D.S.E. (C.S.W.) VI**



This is a complete composite kit in biology for the three years of the middle stage. Biology, like physics, is introduced in the very first year of the middle school stage. Earlier, for implementation of the Pilot Project in various States, a small kit known as Biology Kit No. I was developed and fabricated to meet the immediate requirements of the first year classes of the experimental schools. Now this kit has become only a part of the main kit under discussion. The first year course of the middle school biology deals with the Plant Life (Botany) the second year with Animal Life (Zoology) and the third year with Human Life (Physiology).

The earlier version of Biology Kit No. I

contained improvised apparatus for the study of Plant Life. It contained 17 items in all and one of the items, *viz.* the Heliotropic Chamber was also used as a kit box. A list of these items is given below :

- B—1. Carrot Osmometer
- B—2. Heliotropic Chamber
- B—3. Root growth apparatus
- B—4. Biological file
- B—5. Herbarium press
- B—6. Root pressure apparatus
- B—7. Iron tripod stand
- B—8. Dissecting needles (pair)
- B—9. Test tube support
- B—10. Seed burning spoon
- B—11. Auxonometer
- B—12. Microscope (Dynam type)

- B—13. Dissecting microscope (box type)
- B—14. Hand lens with handle (4 X)
- B—15. Folding lens
- B—16. Box (with 6 slides and 1 doz cover glasses No. 1)
- B—17. Scalpel (Blade 32 mm., metal handle—100 mm. long).

In the main Biology Demonstration Kit for middle stage, some of the above items have been dropped and some others have been modified and the remaining ones kept as such.

This kit is unique in design as it opens up on both sides like the wings of a bird. Thus it provides four sides which are easily accessible for any demonstration. When closed, the kit box measures $600 \times 450 \times 660$ mm. height. Side I contains apparatus for Zoology, side II and III for Physiology and side IV for Botany. The last side also contains General Equipment and Chemicals. Side II and III have a common bottom which also serves as a small storage space for items which could not be accommodated on side walls. Side IV carries a small movable partition wall which provides additional area for storage.

Constructed of wood and thick plywood board, the kit box is sturdy and durable. Flaps opening on both sides are provided with small wheels at the bottom for easy handling. Thus sides I and IV will move in and out without much effort. Special fixtures have been provided on the sides to hold specific items. There will not, therefore, be any mix-up once the teacher knows the position of various pieces of equipment. The design of the kit box facilitates handling as the teacher can get the required items for a specific demonstration from the particular side only.

The kit consists of 100 items including the kit box. This serves as a complete laboratory for demonstration and group activities by the students. As in other cases,

there is no storage problem for this kit. Most of the items are readily available in the market and replenishment is easy. Some basic hand tools are included so that the teacher can undertake minor repairs himself.

Reference Books Published (NCERT)

- (a) *Textbooks*
 - (i) Biology Part I)
 - (ii) Biology Part II) Science for middle schools
 - (iii) Biology Part III)
- (b) *Teacher's Guide*
 - (i) Teacher's Guide for Biology Part I
 - (ii) Teacher's Guide for Biology Part II
- (c) *Kit Guide*

Scientific Topics covered under the New Curriculum

FIRST YEAR.

- (1) The importance of plants in nature
- (2) Cell: Cellular structure of plants
- (3) The seed and its germination
- (4) The root Absorption of nutrients from soil
- (5) Stem Transport of substances in the plants
- (6) Leaf : Preparation of organic substances
- (7) Flower : Reproduction in plants
- (8) Plant as living organisms
- (9) Diversity of plants

SECOND YEAR:

- (1) Introduction to animal life.
- (2) Protozoa
- (3) Coelenterata
- (4) Worms
- (5) Molluscas
- (6) Arthropoda
- (7) Pisces
- (8) Amphibians
- (9) Reptiles
- (10) Birds
- (11) Mammals

THIRD YEAR:

- (1) Classification and evolution of animals
- (2) Introduction to human physiology
- (3) General survey of the human body
- (4) Organs of movements
- (5) Food and digestion
- (6) Blood and blood circulation
- (7) Respiration
- (8) Metabolism
- (9) The skin
- (10) Nervous system and sense organs
- (11) Human development and heredity
- (12) Human body as an integrated whole

LIST OF ITEMS

Sr No Name of the item

Qty

SIDE I : ZOOLOGY

1	Insect display case	One
2	Insect cage	One
3	Insect mounting board (adjustable)	One
4	Net for collecting insects	One
	(a) Handle for insect net	One
5	Bottle for chloroform (Coloured glass, 40 mm di \times 100 mm long with stopper)	One
6	Insect killing jar (Glass, 70 mm dia \times 120 mm long with stopper and a glass tube)	One

SIDE II : PHYSIOLOGY

7	Thermometer (0 - 110°C or -10 - 100°C with 1° graduation)	One
8	Pipette (with 5 and 10 ml marks)	One
9	Glass stirrer (Rod with rubber tubing at the tip)	One
10	Bottle for iodine solution (coloured glass, 25 mm sq. \times 60 mm long fitted with dropper)	One
11	Test tube for collecting saliva	One
12	Test tube I for starch (control)	One
13	Test tube II (for saliva + starch)	One
14	Test tube III (for boiled saliva + starch)	One
15	Test tube IV (saliva + acid + starch)	One
16	Test tube V (saliva + white of egg)	One
17	Starch paste bottle (Polythene - 50 mm dia \times 120 mm. long wide mouth with cap fitted)	One
18	Bottle for glucose - same as Sr No. 17	One
19	Test tube IA	One
20	Test tube IIA	One
21	Test tube IIIA	One
22	Test tube IVA	One
23	Test tube VA	One
24	Bottle for 10% NaOH - same as Sr No. 17	One
25	Bottle for 0.3 CuSO ₄ - same as Sr No. 17	One
26	Iron tripod	One
27	Water bath (Aluminium tumbler 75 mm dia \times 105 mm long)	One
28	Wooden discs with holes for support of test tubes and thermometer	One
29	Kerosene lamp	One
30	Apparatus to test exhaled and inhaled air	One
31	Bottle for lime water Ca(OH) ₂	One
32	Donder's Chamber (Apparatus to show effect of diaphragm on lungs)	One
33	Cannule	One

SIDE III : PHYSIOLOGY

34	Boss heads	Three
35	Clamp with rubber cork	One
36	Beaker 500 ml. (polythene)	One
37	Beaker 150 ml. (polythene)	One
38	Soft pine board with a hole - 25 cm. \times 9.5 cm. - hole 2 cm dia.	One

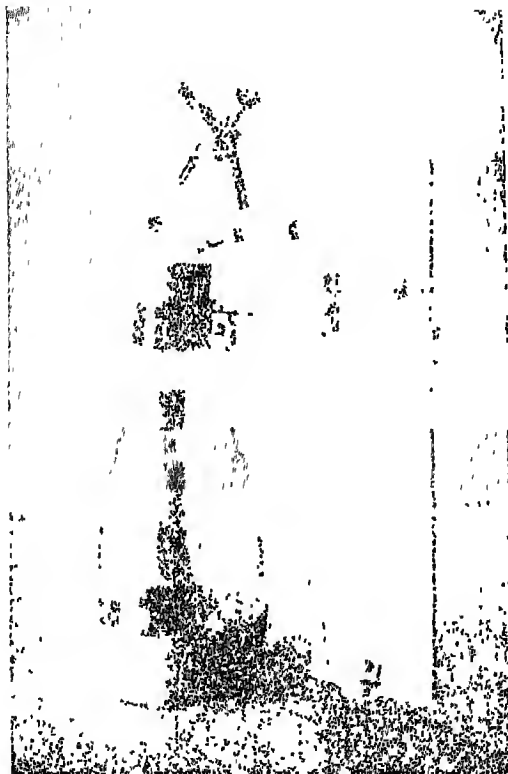
39. Stand for demonstration of muscles contraction (Myoseope)
 (a) Scale—Semi circular
 (b) Pointer with a block Auxonometer One
 (c) Electrodes One
 (d) Bone holder One
 (e) Weights (two rubber corks Nos 2 and 8) One
 (f) Hook for tendon of museles One
 (g) Hook for heart One
40. Bottle for saline solution (0.7% NaCl)—Polythelene 50 mm. dia. × 120 mm long One
41. Induction coil One
42. Set for cigography
 (a) Bracket with pulley
 (b) Pencil holder with pencil
 (c) Nylon string with hook and loop
 (d) Platform with guide for paper
43. Cotton bag for 5 kg. soil One
44. Dissecting tray with wax (aluminium) One

SIDE IV . BOTANY, GENERAL EQUIPMENT AND CHEMICALS

45. Tube and cork for carrot osmometer
 (a) Glass tube 4 mm bore × 370 mm long One
 (b) Rubber cork 30 mm dia × 45 mm One
46. Root growth apparatus One
47. Botanical file (pair) One
48. Botanical press (pair) One
49. Test tube stand One
50. Seed burning spoon One
51. Dissecting microscope One
52. Slide box (with 20 slides and 20 cover glasses) One
53. Apparatus for respiration of seeds One
54. Apparatus for transpiration One
55. Capillary glass tubes, outside dia 5 mm
 (a) Length 185 mm. bore 4 mm. One
 (b) Length 185 mm bore 2.6 mm One
 (c) Length 185 mm. bore 2 mm. One
 (d) Length 185 mm. bore 1.2 mm. One
 (e) Polythene thick tube dia. 15 mm × 115 mm long One
 (f) Stand for the above One
56. Soil sample tubes 3 Nos
57. Petri dish (Plastic, 115 mm dia. × 30 mm. high) One
58. Test tube holder One
59. Triangular file 130 mm. One
60. Garden trowel 230 mm. One
61. Pruning knife 220 mm. One
62. Secateur 180 mm. One
63. Fret saw 165 mm. One
64. Dissecting set One set
 (a) Scissors surgical 125 mm. One
 (b) Scissors fine point 110 mm. One
 (c) Forceps straight (pointed) 120 mm. One
 (d) Forceps straight (blunt) 130 mm One
 (e) Dissecting scalpel 50 mm blade One

(f) Dissecting needles	Two
(g) Blunt probe 120 mm.	One
65. Syringe (plastic 2 c c)	One
66. Needle for syringe (No. 18)	One
67. Measuring compass (Divider)	One
68. Dropper (plastic)	One
69. Razor blade	One
70. Marker for roots	One
71. Ruler (plastic 30 cms.)	One
72. Container for NaOH (Chemical proof transparent plastic, 25 mm. dia. x 80 mm long with cap. cylindrical)	One
73. Container CuSO ₄ (Chemical proof transparent plastic, 25 mm. dia x 80 mm. long with cap. cylindrical)	One
74. Container for pins, threads -do-	One
(a) Pins, (b) Threads, (c) Hooks (d) Sewing needle	
75. Container adrenalin -do-	One
76. Container litmus (Chemical proof transparent plastic, 25 mm dia x 80 mm long with cap. cylindrical)	One
77. Container for glucose -do-	One
78. Container for starch -do-	One
79. Container for CaCl ₂ -do-	One
80. Container for Citric acid -do-	One
or Sodium, Aluminium or Potassium Oxalate	
81. Container for NaCl -do-	One
82. Bottle for HCl Conc (Plastic, acid proof, 50 mm dia x 120 mm. long with cap.)	One
83. Bottle for H ₂ SO ₄ Conc. -do-	One
84. Bottle for HNO ₃ Conc. -do-	One
85. Bottle for spirit -do-	One
86. Reagent bottle for 10% HCl—same as Sr. No. 17	One
87. Reagent bottle for 0.5% H ₂ SO ₄ -do-	One
88. Reagent bottle for 20% HNO ₃ -do-	One
89. Reagent bottle for CaCl ₂ -do-	One
90. Container for CaO -do-	One
91. Splints for legs	One pair
92. Splints for arm	One pair
93. Tourniquet (plastic and rubber)	One
94. Bandages—85 mm. wide	One roll
95. Cotton wool, surgical	One oz
96. Muslin cloth 25 cms. 1 metre	One piece
97. Blotting paper	One sheet
98. Heliotropic Chamber	One
99. Support for bottles (at S. No 80-85 inside the heliotropic chamber)	One
100. Kit Box	One

Examples of Improvisation
22 —DONDER'S CHAMBER (S. No. 32)



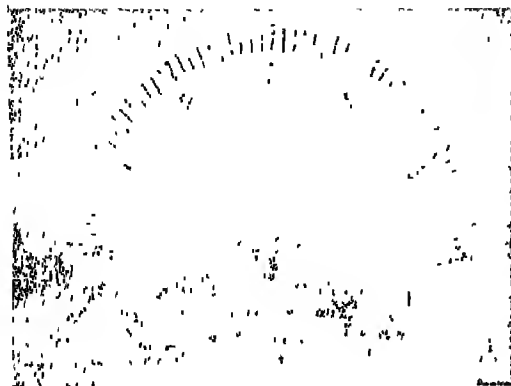
Requirements

- (i) Improvisation of conventional Donder's Chamber to illustrate breathing movement in human beings.
- (ii) It should be a simple device and big enough for observation by young children.
- (iii) There should not be any difficulty in replacing the parts even in rural areas.
- (iv) Should be inexpensive.

The Prototype

The prototype fulfils all the requirements. Made out of readily available material in the market, it will not create any problems of replacement. Even the complete prototype can be made by the teacher. It is very inexpensive and serves the purpose well.

23—MYOSCOPE (S No 39)

**Requirements**

- (i) A device to measure the contraction of muscle during reflex.
- (ii) A source to provide electric shock.
- (iii) A scale to indicate deflection.
- (iv) The device should be as simple as possible and large enough for class demonstration.
- (v) If possible, it may be used in several other experiments to reduce the cost

The Prototype

The prototype fulfils all the conditions. It utilizes the scale of the auxonometer and induction coil so as to reduce its cost. The device is simple so that the pupils can understand its working and the movement of the pointer on the scale can be noticed from a distance.

24—SET FOR ERGOGRAPHY (S. No 42)

**Requirements**

- (i) A device to indicate the muscle fatigue
- (ii) It should be simple and sturdy
- (iii) It should be flexible to measure fatigue of the muscle of a strong as well weak pupil.
- (iv) It should be inexpensive.

The Prototype

The device fulfils all the requirements. It is simple and demonstrative. One bag after the other of the sand bags can be added up to a weight of 5kg. and thus pupils of different physique can perform the experiment. The movement of lead pencil will provide clear indication of the fatigue undergone by the muscle. It is sturdy and inexpensive.

25—ROOT GROWTH APPARATUS (S. No 46)

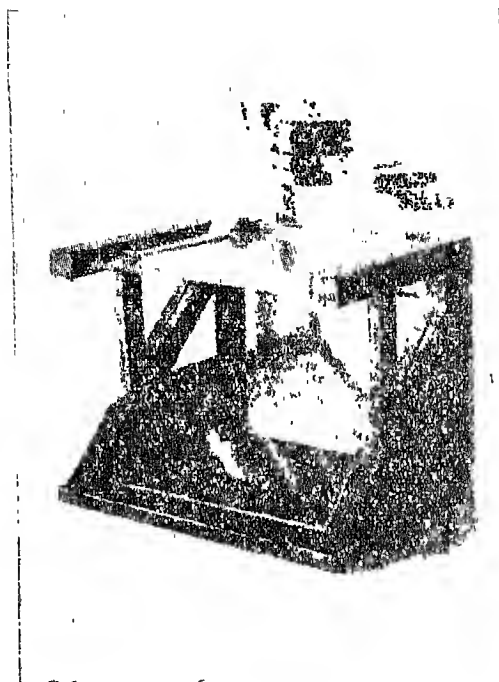
**Requirements**

- (i) A device to illustrate the growth of roots
- (ii) The growth should be visible
- (iii) It should indicate the direction of growth and effects of various factors
- (iv) Should be simple and sturdy.
- (v) It should be inexpensive.

The Prototype

It fulfils all the requirements. The container has a glass surface and a metallic cover. It can rotate around the horizontal axis to provide various angular positions. Container can store sand and preserve moisture in any position. It is portable and the glass surface can be exposed to light

The growth of roots and its direction are easily observed. The effect of moisture is also clearly noticed. The device is simple, sturdy and inexpensive.

26—DISSECTING MICROSCOPE (*S. No. 51*)**Requirements**

- (i) A simple sturdy and inexpensive model of a microscope with a platform to perform dissection
- (ii) Total magnification of $20\times$ with adjustment to indicate $10\times$ magnification as well
- (iii) Easy to handle.

The Prototype

Made of plastic body, it has two lenses

which can be taken out easily. For focusing, it can be adjusted with a small force by lifting or lowering these lenses whose support slides tightly inside a sleeve. There is a small platform with holding device so that both hands of the pupil are free to perform dissection. It is so inexpensive that every school can easily afford to have a few sets for pupil's use.

BIOLOGY PART I—BOTANY**Sr. No. Demonstration**

1. Study of parts of a flowering plant
2. Study parts of a flower

3. Preparation of herbarium specimens of different types of plants
4. Examination of cells by the hand lens and by means of dissecting microscope

- 5 Study of the parts of a microscope. Rules of handling a microscope
N B The microscope is not supplied in the kit But it should be borrowed from the Senior High School or a neighbouring school
- 6 Preparation of a temporary wet mount of onion peel and examining the same under this microscope
- 7 Examination of soaked seeds of bean and maize
- 8 Composition of seeds Detection of water in seeds
- 9 Detection of mineral substance By burning seeds in the metal spoon and obtaining the ash
- 10 Detection of starch
 Starch test
 - (a) in the seed
 - (b) in flour (muslin bag expt)
- 11 Detection of protein (product obtained from expt 10 (above))
- 12 Detection of oil By scratching or pressing seeds on paper
- 13 Experiments to demonstrate that germinating seeds respire
 - (a) Germinating seeds produce CO_2
 - (b) Germination seeds produce heat
- 14 Demonstration experiment to show the conditions necessary for germination
 - (a) role of water
 - (b) role of air
- 15 Preparation of herbarium specimens of different stages of seed germination
 - (a) for a dicot seed (bean)
 - (b) for a monocot seed (maize)
- 16 Germination of dicot seed and monocot seed in root growth apparatus (for comparison)
- 17 Germination of seeds at different depths
- 18 Effect of removal of parts of cotyledons on growth of seedlings
- 19 Demonstration of different kinds of soil
 - (a) sandy soil
 - (b) clayey soil
 - (c) loamy soil
- 20 Detection of organic substance in soil
- 21 Detection of moisture
- 22 Detection of air in soil
- 23 Demonstration of mineral substances in soil
- 24 Separation of sand and clay from soil (in test tubes)
- 25 Demonstration of the rate of penetration of water in different types of soil (3 test tubes and muslin cloth)
- 26 Demonstration of rise of water in soil Experiment with capillary tubes
- 27 Demonstration of different types of root systems.
 - (a) fibrous root system
 - (b) tap root system
- 28 Demonstration of effect of cutting the tip of root on the growth of lateral roots
- 29 Demonstration to show different zones of growth at the root tip
- 30 Experiment to demonstrate structure of root hairs, root cap, etc
- 31 Demonstration of internal structure of roots (no details)
- 32 Demonstration of absorption of water by roots
- 33 Demonstration of absorption of water by roots Experiment with a carrot osmometer
- 34 Demonstration of root pressure
- 35 Experiment to demonstrate the effect of fertilizers on seedlings
- 36 Demonstration of structure of bud with a lens
- 37 Experiment to demonstrate zones of growth at the stem tip
- 38 Demonstration of internal structure of stem (no details)
- 39 Demonstration experiment showing transport of substances in a balsam
- 40 Demonstration experiment to show the effect of light on the growth of stem tip
- 41 Study of annular rings in a cut section of stems (timber or logs)
- 42 Study of underground stems, modified for different functions
- 43 Demonstration of internal structure of leaf (no details)
- 44 Demonstration of presence of stomata in leaves Forcing air by pressure into the petiole by means of a pump (supplied with primary science kit)
- 45 Demonstration of chloroplast in leaf cells (through microscope)
- 46 Extraction of chlorophyll from leaves
- 47 Functions of leaves photosynthesis
 - (i) Formation of starch in the presence of light
 - (ii) Evolution of O_2 during photosynthesis (funnel and test tube experiment)
- 48 Demonstration of transpiration (improvised potometer in the kit) Repeat experiment 26 to show capillary action in the rise of water in stems)
- 49 Study of structure of flowers
- 50 Demonstration of the technique of pollination (transferring pollen by artificial methods)
- 51 Demonstration of grafting
 - (i) Simple grafting

- (ii) bud grafting (use of tools)
- 52 Demonstration of vegetative propagation
 - (a) cutting, etc
 - (b) use of trowel

BIOLOGY PART II – ZOOLOGY

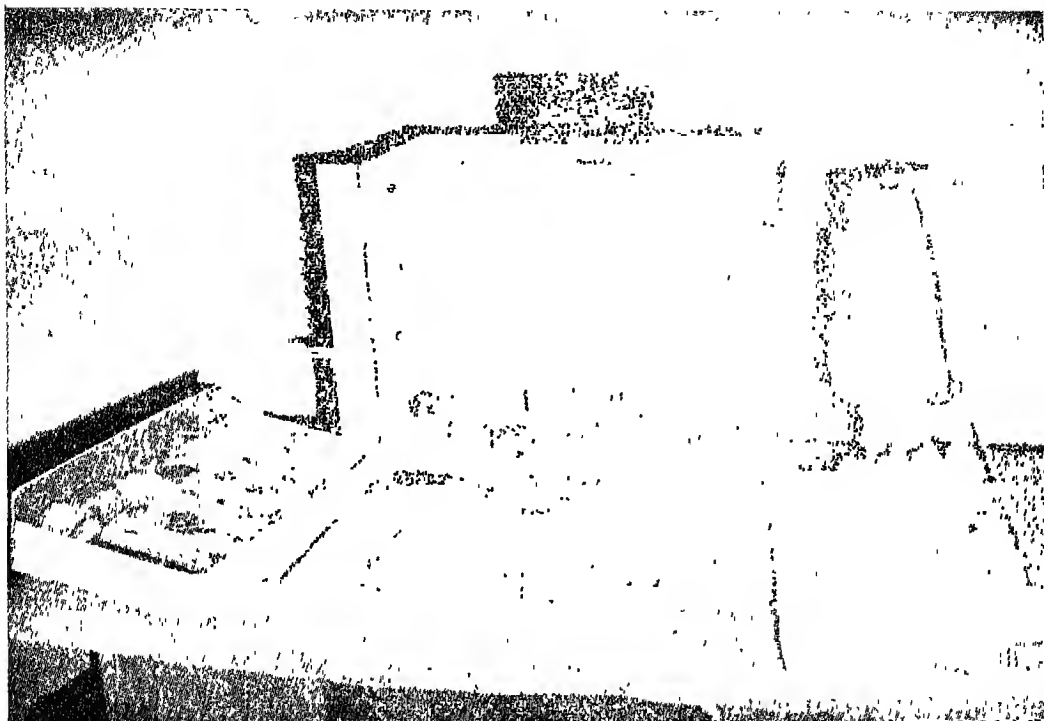
- 53. Study of living protozoa (*Amoeba* and *Paramecium*). Their structure and their life activities
- 54. Study of living *Hydra*
- 55. Study of the external features of earthworms
- 56 Examination of external features of cockroaches
- 57 Dissection of cockroach to show the gross internal structure
- 58 Demonstration of reproduction and development of insects
- 59 Observation of insects in the field and their collection, preservation, drying and display
- 60 Study of the external structure of fish
- 61 Examination of external features of frog
- 62 Demonstration of internal organs in a dissected frog
- 63 Examination of the external features of a house lizard
- 64. Study of the external features of a pigeon with reference to its adaptations
- 65. Study of internal structure of pigeon in a dissected specimen (parts only)
- 66 Examination of the structure of an egg (hen's egg)
- 67. Examination of the external features of rabbit or rat
- 68. Demonstration of the internal organs in a dissected rabbit or rat

BIOLOGY PART III—HUMAN PHYSIOLOGY

- 69. Demonstration of the cells of the epithelium of the mouth cavity of man under the microscope
- 70. Examination of connective tissue
- 71. Examination of striated tissue in smooth muscle
- 72. Demonstration of the properties of nervous tissue
- 73 Demonstration of reflexes in frog
- 74 Demonstration of the different elements which take part in a reflex arc
- 75. Demonstration of the structure and chemical composition of bones
- 76. Demonstration of the structure of joints (different types)

- 77 Demonstration of first aid in case of fractures and dislocation of bones
- 78 Structure and properties of skeletal muscles
- Control of muscles by nerves
- 79. Demonstration of muscle fatigue
- 80. Demonstration of the action of saliva on starch
- 81 Demonstration of the action of gastric juice on protein
- 82 Experiment to demonstrate absorption, as an active physiological process
- 83. Demonstration of composition of blood (separation in test tube with anticoagulant)
- 84 Demonstration of coagulation of blood
- 85 Examination of blood under the microscope
 - (i) human blood
 - (ii) frog's blood
- 86 Demonstration of circulation of blood in the web of frog's foot
- 87 Demonstration of the structure of the heart of sheep
- 88 Demonstration of the working of the heart
- 89 Demonstration of the effect of adrenaline and nicotine on the working of the heart
- 90. Demonstration of the arterial and venous system in rabbit or rat (injected and dissected specimens)
- 91. Demonstration of first aid during haemorrhage
- 92 Demonstration of respiratory organs of frog
- 93 Demonstration of the relative content of CO_2 in inhaled and exhaled air
- 94 Demonstration of the mechanism of inspiration and expiration with the help of
 - (a) rubber balloons in a bell jar
 - (b) with freshly dissected lungs from a frog (Donder's Chamber)
- 95 Examination of dissected kidney of a mammal
- 96 Examination of slides of the skin of frog
- 97 Demonstration of the nervous system in dissected mammal (rat or rabbit)
- 98 Demonstration of the spinal reflexes of frog (decapitated earlier)
- 99. Inhibition of reflexes in frog
- 100 Study of the eye of sheep or frog
- 101. Demonstration to identify the distribution of density of receptors
- 102 Demonstration of the formation and inhibition of pupillary reflexes in man
- 103 Demonstration of frog's eggs
- 104 Demonstration of chick's embryo in the egg

CHEMISTRY DEMONSTRATION KIT FOR MIDDLE STAGE D.S.E. (C.S.W.) VII



For the teaching of chemistry at the middle school level, a chemistry demonstration kit has been designed and developed. This is in fact a 'mini laboratory' consisting of glass apparatus, chemicals, containers and devices for performing demonstrations and experiments. All these items of equipment are packed in a cabinet which forms a compact portable box and can be used in any classroom. The kit would enable not only most of the classroom demonstrations to be performed as are included in the syllabus, but would also help in co-curricular activities in the school.

This demonstration kit includes some common glassware, general equipment, set

of tools, chemicals and some improvised apparatus. The selection of equipment of the kit has been made in such a way that about 80 to 90 per cent of all the experiments of any chemistry course at the middle stage can be demonstrated. The liquid chemicals have not been supplied and have to be arranged locally. Containers for such items have been included. While developing the kit, special attention has been paid to design new experiments and use equipment made from simple indigenous materials. A number of conventional apparatus have been replaced by improvised ones.

The kit box measures 620 mm. \times 320 mm. \times 600 mm. height and has been made out of

wood, ply and hardboard. There are four compartments from top to bottom. The first three consist of trays which can be pulled out and the last one is a lid hinged at the bottom. The trays contain glassware and chemicals and the bottom compartment provides storage space for general items like gas collecting device, laboratory stand, various holders and fixtures, weighing balance, pump, rubberware, etc. The inside surface of the lid has been utilised to hold some of the equipment.

The kit is supplemented by a Pupil's Kit with which a group of students can perform individual experiments. Thus for a middle school a set of one demonstration kit and five pupil's kits will provide a complete laboratory.

A kit guide has been specially prepared and is sent along with the kit so that the teacher becomes familiar with the items of the kit and also knows how to use the items in various activities. To help the teacher, instructions on the preparation of solutions and safety precautions have been specially dealt with. In addition, a special chapter has been devoted to indicate the necessity of first aid box and instructions for providing first aid in case of accidents or mishaps in a chemistry class. Illustrations of some of the assemblies and experiments are also given at appropriate places.

Reference Books Published by NCERT

1. Textbooks

1. Chemistry Part I
Science for Middle Schools

2. Chemistry Part II
Science for Middle Schools

II Teacher's Guides

1. Teacher's Guide for Chemistry Part I
2. Teacher's Guide for Chemistry Part II

III Kit Guide

Kit Guide for Chemistry Demonstration Kit for Middle Schools.

IV Pamphlets

1. Experimental methods of teaching chemistry
2. Some suggested improvisations for chemistry experiments
3. General techniques of performing experiments in chemistry
4. Techniques and methodology in preparing chemistry experiments

Scientific Topics covered under the New Curriculum

FIRST YEAR

1. Substances and the changes that take place in them
2. Structure and composition of substances
3. Oxygen, Air
4. Hydrogen
5. Water and solutions
6. Oxides, Bases, Acids and Salts.

SECOND YEAR

1. Important Classes of Inorganic Compounds
2. Chemistry in Agriculture
3. Carbon and its Compounds
4. Metals
5. Importance of Chemistry in National Economy—Development of Chemical Industry in India.

LIST OF ITEMS

Sr. No.	Name of the item	Detail Description	Qty.
1	Kerosene Lamp	(a) Ink Bottle (b) Wick Holder with 3 Clamps (c) Perforated Chimney (tin sheet)	1
2.	Petrol Gas Generator	(a) Bunsen Burner (b) Reagent Bottle (500 ml. wide mouth) (c) Football Bladder No. 5	1

3	Laboratory Stand	(a) Clamp Holder (boss-head) (b) Clamp Extension (c) Ring Extension (d) Base (e) Rod	1
4	Tripod Stand	Triangular type	1
5	Test tube Stand	Polythene for six test tubes	1
6	Test tube Holder		1
7	Balance	10 mg to 100 g	1
8	Weight Box		1
9	Measuring Cylinder, Soda Glass	100 ml with 1 ml. graduation	1
10	Measuring Cylinder, Soda Glass	25 ml. with 1 ml. graduation	1
11	Pipette, Mohr's type, Soda Glass	10 ml., one mark	1
12	Dropper	Polythene, as per sample	1
13	Burette, Soda Glass	25 ml., 0.1 ml. graduation	1
14	Thermometer	—10° to 110°C, graduation 1°C with plastic cover	1
15	Volumetric Flask with ground Glass Stopper, Soda Glass	100 ml. with one mark	1
16	Gasometer with Gas	(a) Tin Can (5 litre) (b) Tin Can (3 litre) (c) Nozzles	1
17	Kipp's Apparatus	Reagent Bottle, 125 ml. wide mouth	1
18	Liebigs Condenser	Soda Glass Pipe Tube, 2.5 cm dia. x 33 cm long	1
19	Voltmeter/Bell-Jar Holder	Glass Reagent Bottle wide mouth without bottom (transparent), 10 cm dia. x 12 cm long Carbon electrodes 7 mm. dia x 60 mm long (2 Nos.) Plastic coated $\frac{1}{2}$ metre long wires with crocodile clips at one end and banana plug at other end (2 sets)	1 2 sets
20	Cork Borer (Set of six borers)	Standard	1 set
21	Triangular File with wooden handle	6" long	1
22	Triangular Clay Pipe	Standard	1
23	Spatula	Standard (Plastic or Horn)	1
24.	Spoons (a) Size of half tea spoon (b) Size of three tea spoon }	Plastic	1 each
25	Test Tube Brush	Standard (Brush is made of plastic)	1
26	Pinch Cock (Clamp) (a) Mohr's type (b) Screw type	Standard -do-	2 2
27	Knife/Sharpened Hacksaw Blade, 100 mm long	As per sample	1
28	Deflagrating Spoon		2
29.	Holder for 3 Dry Cells	(a) Holder (b) Plastic coated wires $\frac{1}{2}$ metre long with two banana plugs at the ends	2

30.	Pan of Tongs	16 cms. long	1
31	Scissors (blunt)	14 cms. long	1
32.	Wire Gauze with Asbestos in the Centre	10 cm. x 10 cm.	2
33	Blow Pipe	Metallic (26 cm. long)	1
34	Test Tube	Soda Glass (13 cm. x 1.7 cm.) One with a hole at the bottom	18
35.	Long Test Tube	Hard Glass (13.5 cms. x 2 cm.)	2
36.	Boiling Tubes	Hard Glass (15 cm. x 2.5 cm.)	6
37	Beakers	(a) 100 ml.	1
		(b) 250 ml.	1
38.	Conical Flask, Soda Glass	150 ml.	1
39	Funnel	Soda Glass dia. 7.5 cms., 60° stem	1
40	Watch Glass	(a) 5 cms. dia.	1
		(b) 7.5 cms. dia.	1
41	Set of Delivery Tubes	(a) 45° 3 x 4 cm.	2
	6 mm dia. outside, Soda Glass	(b) 90° 3 x 4 cm.	6
		(c) 90° 3 x 17 cm.	2
		(d) 90° 4 x 17 cm. (with a jet at longer tube)	1
		(e) 120° 3 x 4 cm.	3
		(f) U type 2.5 cm. each arm	2
		(g) 90° 4 x 5.5 cm.	1
		(h) 90° 12 x 20 cm.	1
42	Glass Rod	15 cms. long, 6 mm. dia.	2
43	Set of Glass Tubing	(a) Glass Tubing 11 cm. long (dia. outer 6 mm.)	3
		(b) Glass Tubing with Jet 17 mm. (dia. outer 6 mm.)	1
		(c) Glass Tubing 14 cm. (dia. outer 6 mm.)	2
		(d) Glass Tubing 7 cm. (dia. outer 6 mm.)	3
		(e) Glass Tubing with jet 5 cm. (dia. outer 6 mm.)	3
		(f) Glass Tubing 30 cm. (dia. outer 6 mm.)	2
		(g) Glass Tubing 6 cm. long (outer dia. 8 mm.)	2
		(h) 42 cm. long (6 mm. dia.)	1
44.	Rubber Tubing	(i) 6 cm. long with copper coil inside	1
		(a) Two metre (dia. 6 mm. outside)	1
		(b) 1.1 metre (dia. 10 mm. outside)	1
		(c) 2.5 cm. (dia. 6 mm. outside)	25
		(d) 2.5 cm. (dia. 8 mm. outside)	1
		(e) 7 cm. (dia. 8 mm. outside)	1
		(f) 5 cm. (dia. 8 mm. outside)	1
		(g) 60 cm. (dia. 8 mm. outside)	1
		(h) 25 cm. (dia. 6 mm. outer)	1
		(i) 3 metre (dia. 6 mm. outside)	1
45.	Trough (Polythene)	15 cm. dia. x 7 cm.	1
46	China Dish	10 cm. diameter	1
47.	Pestle and Mortar	Pestle 5 cm. dia.	1
		Mortar 8 cm. length 1.25 cm. dia.	1

48	Gas Jars (Glass) with three discs	450 ml	2
49	Glass Plate	7.5 cm \times 2.5 cm	4
50	Hard Glass Pipe Tube (Both sides open)	12 cm \times 2 cm	1
51	Round Bottom Flask, Corning	(a) 500 ml	1
52	Flat Bottom Flask, Corning	(a) 500 ml.	1
		(b) 100 ml.	1
53	Rubber Stoppers	(a) No 16 \times with two holes (for 6 mm tube)	1
		(b) No 16 \times with two holes (for carbon electrodes)	1
		(c) No 16 \times with a small hole for deflagrating spoon	1
		(d) No 13 with a hole in the centre for introducing test tube	1
		(e) No 6 with a hole in the centre (for glass tubing)	2
		(f) No 6 with two holes (6 mm. dia.)	4
		(g) No 2 with one hole (for 6 mm. tube)	1
		(h) No 2 without hole	1
		(i) No 4 with one hole (for 6 mm tube)	2
		(j) Cork for 125 ml wide mouth bottle	1
54	Rubber Ring	Dia 2 cm with a hole (for 6 mm tube)	1
55.	Match Box	Ordinary	1
56.	Cotton	Ordinary	25 gms.
57.	Duster	Ordinary (Standard size)	1
58	Litmus Paper (Blue and Red)	Ordinary type (Two each)	4 pkcts.
59	Filter Paper	-do-	2 sheets
60	Candles	-do-	2 pieces
61	Wooden Splinters (10 cm \times 5 cm)	-do-	24 pieces
62.	Metallic strips	Copper —2pcs Iron —7pcs. Aluminium—2pcs. Zinc —2pcs Lead —1pc. } 15 mm. \times 70 mm. size	13 Pcs.
63.	Washing Bottle 250 ml	Polythene	1

LIST OF CHEMICALS AND BOTTLES

Sr. No.	Chemicals	Quantity	Type of container
1.	Nitric Acid (Conc. Dil)		A + A
2	Sulphuric Acid -do-		A - - A
3	Hydrochloric Acid -do-		A - - A
4.	Phosphoric Acid (Dil)		A
5	Crude Oil		A

6	Lime Water		B
7	Barium Chloride		B
8.	Sodium Hydroxide		B
9.	Petrol		B
10.	Calcium Hydroxide		B
11.	Kerosene Oil		B
<hr/>			
			6
12.	Sodium Chloride	160 gms	C
13.	Potassium Permanganate	100 gms.	C
14.	Marble Chips	350 gms.	C
15.	Copper Sulphate	150 gms	C
16.	Zinc Pieces	300 gms	C
17.	Sodium Metal		C
<hr/>			
			6
18.	Sugar	80 gms.	D
19.	Sulphur	20 gms.	D
20.	Charcoal	15 gms.	D
21.	Calcium Oxide	10 gms.	D
22.	Potassium Chloride	7 gms.	D
23.	Ammonium Nitrate	10 gms.	D
24.	Potassium Sulphate		D
25.	Copper Carbonate (Basic)	25 gms	D
26.	Ammonium Sulphate		D
27.	Calcium Phosphate		D
28.	Calcium Super Phosphate		D
29.	Calcium Nitrate		D
30.	Potassium Chloride		D
31.	Urea		D
32.	Potassium Nitrate		D
<hr/>			
			15
33.	Nepthalene Balls	10 gms.	L
34.	Sodium Metal		E
35.	Starch	25 gms	E
36.	Calcium Hydroxide	30 gms.	E
37.	Phosphorus (Red)	13 gms.	E
38.	Magnesium Ribbon	15 gms	E
39.	Copper Oxide	120 gms	E
40.	Sodium Acetate	10 gms.	E
41.	Boric Acid	7 gms	E
42.	Potassium Sulphate	7 gms	E
43.	Mercuric Oxide (Yellow)	50 gms.	E
44.	Copper Turnings	25 gms	E
45.	Formic Acid	10 gms	E
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			13
46.	Litmus Solution		F
47.	Phenolphthalein		F
48.	Methyl Orange		F

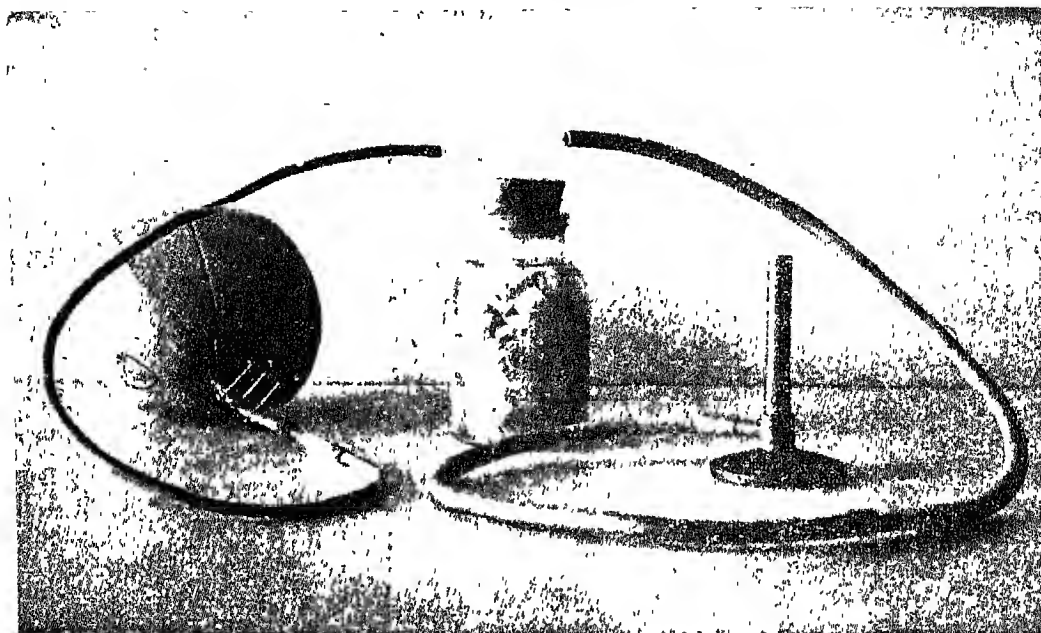
49.	Vegetable Oil		G
50.	Bromine Drops		G
51.	Vinegar		G
52.	Spirit		G
			<hr/>
			4
53.	Zinc Dust	6 gms.	H
54.	Iron Powder	25 gms.	H
55.	Magnesium Powder	25 gms.	H
56.	Barium Chloride	5 gms.	H
57.	Silver Nitrate	1 gm.	H
58.	Phenolphthalein	1 gm.	H
59.	Methyl Orange	1 gm	H
			<hr/>
			7
60.	Iron Wire	} 1 mm. dia 70 mm. long—10 Pcs	K
61.	Aluminum Wire		K
62.	Copper Wire		K
63.	Iodine Crystals	20 gms.	K
64.	Potassium Chloride	10 gms.	K
			<hr/>
			5
65.	Silver Nitrate	1 gm	X
66.	Scent		Y
67.	Sodium Hydroxide		Z

DESCRIPTION OF BOTTLES

- | | |
|--|--|
| <p>A. Bottle (Acid and base proof) 48 mm. dia , 101 mm. long with a screw cap</p> <p>B. Bottle (Acid and base proof) 43 mm., dia , 104 mm. long with a screw cap.</p> <p>C. Cylindrical container polythene 63 mm. dia., 80 mm length with inside lid and screw cap</p> <p>D. Wide mouth polythene bottle, 48 mm. dia., 95 mm long wide screw cap.</p> <p>E. Cylindrical container polythene 37 mm. dia. 80 mm. long with a screw cap.</p> | <p>F. Polythene bottle, with inside nozzle, and a screw cap 40 mm dia., 75 mm. long</p> <p>G. Polythene bottle, 40 mm dia., 81 mm. long with inside lid and screw cap,</p> <p>H. Polythene tube, 20 mm. dia., 54 mm. long with screw cap</p> <p>X. Coloured bottle, 25 ml., with dropper.</p> <p>Y. 5 ml. bottle filled with scent.</p> <p>Z. 125 ml. glass bottle wide mouth.</p> <p>K. Cylindrical container plastic 20 mm. dia. × 80 mm. dia. with screw cap.</p> |
|--|--|

Examples of Improvisation

27. PETROL GAS GENERATOR (S N 2)



Requirements

Although a kerosene lamp had been provided for normal use for heating, it was required to include a burner for heating to higher temperatures. It meant improvisation of a gas plant which is normally available in high schools and colleges. It should be inexpensive, safe and simple so that it is within the reach of a middle school where it could be utilized both by the teacher and the pupils.

The Prototype

The device is quite simple. A football bladder or an old car tube is filled with air by the pump to supply air which goes to the petrol container. Wooden shavings are put in petrol to increase the surface area. Vapour of liquid petrol make the combustible gas which is directly fed to the Bunsen

burner. Stop Cocks have been provided to regulate the supply of gas. A safety valve has been introduced by putting a glass tube containing copper spiral in between the two pieces of rubber tubing connecting the burner to the bottle containing petrol and wooden shavings. This will avoid any back-flash.

This is an ideal device for generating petrol gas in a village school. It is quite inexpensive. All the parts can be replaced easily and supply of petrol is no problem.

Precaution

A long rubber tube should be used to keep safe distance of the petrol bottle from the burner. A thick copper spiral in glass tube must be inserted in this rubber tube as it will check any flames from going to the petrol container from the burner.

28. GASOMETER (GAS HOLDER) (S. No 16)

**Requirements**

A gas holder for the storage of gases insoluble in water was required. It should be sturdy, inexpensive and simple. It called for replacement of conventional glass holder which might break by mishandling.

The Prototype

The prototype made of two used tin containers of 5 litre and 3 litre capacity with other fittings fulfils all requirements. It is sturdy and there is no question of its breaking

even by mishandling. The outer container is filled with water and the smaller container without a bottom slides inside till all the air is expelled. The pinch cock at the top is then closed. The delivery tube is led to the bottom of the inside container which stores the gas. It is lifted up automatically when pressures of the gas builds up further. There is an outlet at the top of the gas holder which is connected to the delivery tube for supplying gas to perform experiments. Supply is regulated by a pinch cock.

29. IMPROVISED KIPP' APPARATUS (*S. No. 17*)**Requirements**

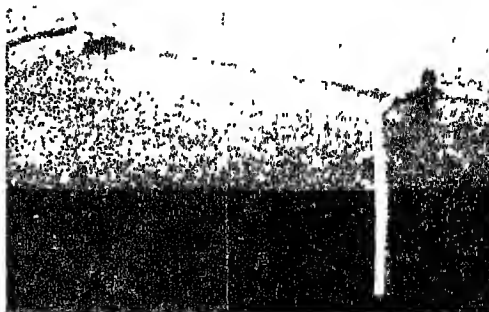
- (i) A device to replace the conventional Kipp's apparatus for continuous intermittent supply of hydrogen and carbon dioxide gases.

The Prototype

The device was improvised by providing a fine hole in ordinary glass test tube which is suspended inside a reagent bottle through a rubber stopper. This hole can be made by closing the mouth of test tube with a rubber cock and heating the bottom on a flame till it becomes soft. Expansion of air forces a hole through the soft bottom. The bottle is partly filled with dilute hydrochloric acid. Marble chips or zinc pieces are put inside the test tube according to requirement of carbon dioxide

or hydrogen gas. The test tube is fitted with a rubber cork through which passes the delivery tube. A pinch cock may be provided on the rubber tube connecting the delivery tube to regulate the supply of gas

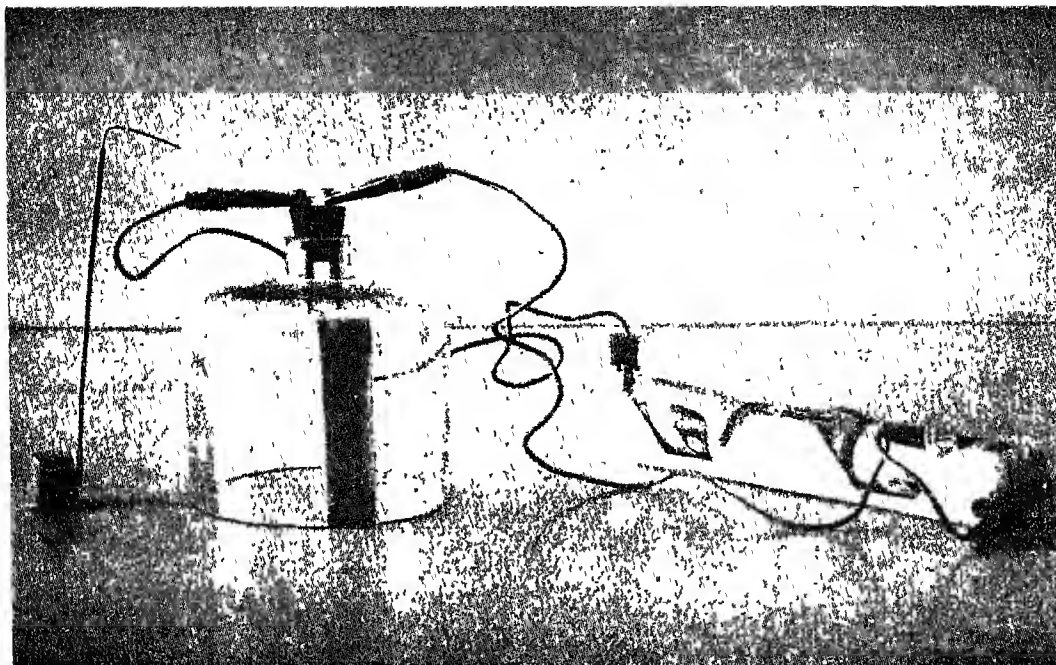
Note. A second variant was also designed and is mentioned at P. 43 of the Kit Guide.

30. LIEBEG'S CONDENSER—IMPROVISED DISTILLATION APPARATUS (*S. No. 18*)**Requirements**

- (i) An improvisation of the conventional Liebig's Condenser for fractional distillation of crude oil and distillation of water.
- (ii) Should be simple and inexpensive.

The Prototype

The improvised apparatus is rather simple and eliminates the water pumps or municipal tap water for circulating the cold water which is fed by gravitational force and is collected at the bottom in a bucket. This can again be put in the supply tank manually as and when required. The distilled liquid is conveniently obtained in a beaker. The operation is simple and the parts are easily replaceable.

31. VOLTAMETER/BELL JAR (*S No. 19*)**Requirement**

- (i) A device for the analysis of water and for determining composition of air.
- (ii) It should be simple and inexpensive.

The Prototype

A bottomless narrow mouthed glass bottle serves as a voltameter for analysis of water if inverted and also as a bell jar for determining quantity of oxygen present in air.

As a voltameter, a rubber stopper is provided at its mouth which carries two iron nails each connected to the terminals of 3/4 dry cells. The glass bottle is inverted and 10% solution of sodium hydroxide is put which serves as the electrolyte. This is important to make the iron nails serve as electrodes. Oxygen and hydrogen gases are collected in proportion in the test tubes containing water and inverted over the electrodes

LIST OF DEMONSTRATION EXPERIMENTS**PART I**

<i>Sr No.</i>	<i>Experiment</i>	<i>Apparatus</i>	<i>Chemicals</i>	<i>Items to be arranged locally</i>
1.1	Classification of objects	Test tube (1) watch glass (1) glass bottle (1)	—	Book (1) sheet of paper (1) Notebook (1)

1 2	Handling of a kerosene lamp	Kerosene lamp (1)	—	Kerosene (100 ml.) Match box (1)
1.3	Heating of a liquid in a boiling test tube	Boiling test tube (1) Test tube holder (1) Kerosene lamp (1)/ Burner	—	Water
1 4	Use of wooden or Metallic laboratory stand	Laboratory stand (1) (wooden or metallic)	—	—
1 5	Heating of a solid substance in a test tube (sugar)	Boiling test tube (1) Laboratory stand (1) Kerosene lamp (1) Burner	—	Sugar (10 g)
1 6	Cleaning of a test tube	Test tube (1), Test tube brush (1)	—	Water, Piece of paper
1 7.	Classifying objects in the following groups : (a) Liquids (b) white crystalline substances (c) objects made of glass (d) Metals of glass	Glass tube (1) Glass rod (1)	Sugar (10 g.) Common salt (10 g) Vinegar (10 ml) Naphthalene (10g) Copper (1) Aluminium (1) Iron (1) Zinc (1) Lead (1)	Petrol (10 ml) Kerosene (10 ml.)
1 8.	Determining the boiling point of a liquid	Thermometer (—10° 110°C) Laboratory stand (1) Boiling test tube (1) Kerosene lamp (1) burner	—	Water
1.9	Comparing the melting point of wax and sulphur	Test tubes (2), Beaker (1) (250 ml.) Gas burner (improvised), wire gauze	—	(Sulphur (5 g.), Wax 5 g)
1.10.	Determining the melting of ice	Funnel (1) Thermometer (—10°C 110°C), Beaker (1) Chloride 250 ml, Laboratory stand	Sodium Chloride	Ice
1 11	Pouring of carbon-dioxide gas	Gas jar (1), Beaker 250 ml (1), Kipp's apparatus (improvised) for the preparation of CO_2	Marble chips, HCl or H_2SO_4 (dil.)	Candle
1 12.	The molecular movement	Glass plate (1)	—	—

1.13.	Diffusion of Gases (a) Bromine with air and carbon dioxide (b) Ammonium hydroxide with hydrochloric acid gas (optional)	Gas jar (2) gas jar disc (1) Watch glass (2) Glass tubing with a jet (1) Kipp's app (improvised) for the preparation of CO_2 . (b) Round bottom flask (1) bent tubing 90° (2), Funnel (1), Glass tubing (1), Laboratory stand (1) Gas jar (1), Gas jar disc (1), Kerosene lamp, (1), Watch glass (1), Rubber stopper with two holes (1), Rubber tubing for joints	Bromine drops marble chips, dil hydrochloric acid (b) Ammonium Hydroxide, Sodium Chloride, Concentrated Sulphuric acid	Bottle of scent
1.14	Diffusion of Liquids (Potassium Permanganate and water)	Boiling test tube (1), separating funnel (improvised) Rubber stopper with hole for delivery tube, laboratory stand	Potassium Permanganate	Water
1.15	Inter Molecular Distance	Syringe (1)/foot ball pump (1)	—	—
1.16	Expansion of liquids on heating and contraction on cooling water	Kerosene lamp (1), boiling tube (1), laboratory stand (1), glass tubing 30 cm long, Rubber stopper with a hole	KMNO_4	Water
1.17.	Evaporating the solution	China dish (1), Tripod stand (1), Wire gauze (1), Kerosene lamp (1)/Petrol gas generator (improvised) (1)	—	Sodium Hydroxide and Water
1.18	Effect of impurity on the boiling point of the liquid (common salt in water)	Beaker (1), Glass rod (1), Thermometer (1), Petrol gas generator (improvised) (1), Laboratory stand (1) Wire gauze (1)	Sodium Chloride	Distilled water
1.19	Purification by decantation (Impure water)	Beaker (2), 100 ml. and 250 ml Glass rod (1)	Sodium Chloride	Distilled water
1.20.	Separation of two immiscible liquids (oil and water)	Separating Funnel (improvised) (1), Laboratory stand (1), Boiling test tube (1), Beaker 250 ml. (1), Laboratory stand	—	Vegetable oil and Water
1.21	(a) Preparation of a filter (b) Filtration of an impure liquid (impure water)	Funnel (1), Beaker (1) Glass rod with a rubber tubing at one end, laboratory stand (1), Filter paper Scissors, funnel	—	—

1.22.	Evaporation of water on heating and condensation on cooling	Improvised petrol gas generator (1), Laboratory stand (1), Funnel (1), Beaker 250 ml (1)	—	Water
1.23	Heating of a copper plate	Laboratory stand (1), Petrol gas generator (Improvised), Knife (1)	Copper plate	—
1.24	Studying the changes on heating of starch	Laboratory stand (1) Filter paper (2), Boiling test tube (1), Jet tube (1) Rubber stopper with a hole (1)	Starch	Match-box
1.25.	Freezing water in a test tube	Beaker 250 ml (1), Test tube (1), Test tube stand (1)	Sodium Chloride	Ice, Water
1.26	Indications of a chemical reaction (silver nitrate and sodium chloride or barium chloride with sulphuric acid)	Test tube (3), Test tube stand (1)	Silver Nitrate, Sodium Chloride or Barium chloride, Sulphuric acid	Common salt
1.27	Interaction of dilute Hydrochloric acid with marble chips and testing the gas evolved.	Boiling test tube (1), Bent tubing 90° (1) Bent tubing 45° with a jet (1), Glass tube (1), Rubber stopper with a hole (1), Laboratory stand (1) Rubber tubings (2)	Hydrochloric Acid, Marble chips, Calcium Hydroxide	—
2.1	Decomposition of basic copper carbonate	Boiling tube (1), Test tube (1), Bent tube 90°, Laboratory stand (1), Kerosene lamp (1)	Basic Copper Carbonate, Lime water	Water
2.2	Decomposition of Mercuric Oxide	Boiling test tube (1) Delivery tube (1), Gas jar (1), Laboratory stand (1), Kerosene lamp trough (1), Rubber tubings (2), Rubber stopper with two holes	Mercuric oxide	Water
2.3.	Decomposition of water	Hard glass test tube (2), Holder with 3 dry cells (1) Laboratory stand (1) Voltmeter (Improvised cup), two sets of wire with crocodile plugs	Dilute Hydrochloric acid	Water
2.4.	Reaction of combination (Iron and Sulphur) (a) Mixing together (b) Formation of Iron Sulphide	Beakers (3), Magnet (1), Mortar and Pestle (1), Glass tube (1), Stand (1), Burner (1), Forceps (1), Trough (1)	Iron powder, Sulphur, Iron powder, sulphur	Water

2.5.	Reaction of combination (Zinc dust and sulphur)	as in 2-4	Sulphur, Zinc dust	---
2.6	Law of conservation of Mass (a) Burning of Phosphorous (b) Barium Chloride and dilute Sulphuric acid	(a) Round bottom flask (1), Stopper (1), Kerosene lamp (1), Test tube holder (1), Balance and weight box, (b) Boiling test tube (1), Ignition tube (1), Rubber stopper (1), Balance with weight box	Phosphorous, Barium chloride, Dilute sulphuric acid	a string
3.1	Composition of air	Voltmeter cup (Bell jar) (1), Deflagrating spoon (1), Trough (1), Rubber stopper with a hole for deflagrating spoon (1), Burner	Red Phosphorous	Water
3.2	Preparation of oxygen (Decomposition of Potassium Permanganate)	Boiling tube (1), Laboratory stand (1), Trough (1), Gas jar (2), Bent tubing 120°, 45° (1), Glass tubing (1), Rubber stopper with a hole (1), Improvised petrol gas generator or Kerosene lamp (1)	Potassium Permanganate	Water, Cotton
3.3.	Reaction of oxidation (Burning of carbon, sulphur, phosphorous, magnesium and iron with oxygen and testing the oxide formed)	Gas jars (2), Deflagrating spoon (1), Trough (1), Kerosene lamp or burner (1), A piece of cork	Potassium Permanganate, Charcoal, Lime water, Sulphur, Red Phosphorous, Magnesium Ribbon Steel Wire (from some string instrument)	—
3.4	Preparation of oxygen (Decomposition of potassium chlorate) (Optional)	Boiling tube (1), Test tube holder (1), Kerosene lamp (1), Bent tubing 120° and 45° (2), Jars (2) Rubber joints (2)	Potassium Chlorate	Water
3.5.	Preparation of carbon dioxide by decomposing basic copper carbonate and studying the physical properties of gas evolved	Boiling tube (1), Test tube (1), Bent tube 20° (1), Laboratory stand (1), Kerosene lamp (1)	Basic Copper Carbonate powder, Calcium Hydroxide	Water
4.1.	Preparation of Hydrogen (a) In a boiling tube (b) In Improvised apparatus	Boiling tube (1), Laboratory stand, Improvised Kipp's apparatus (1)	Zinc pieces, Dilute Hydrochloric acid	—

4 2	Physical properties of hydrogen (testing its lightness) (a) Inverting of a cylinder (b) Soap bubbles experiment.	Improvised hydrogen gas generator, gas jars (2), Glass disc (2), China dish (1)	Zinc pieces, dilute Hydrochloric acid, Soap solution, A few drops of glycerine	-
4 3	Burning of hydrogen in oxygen	Improvised hydrogen gas generator (1), Gas jar (2), Apparatus for preparation of O_2	Zinc pieces, dilute Hydrochloric acid, Potassium Permanganate	Water, Match box
4 4	of Hydrogen in air	Improvised hydrogen gas generator (1)	Zinc pieces, dilute hydrochloric acid	Water, Match box
4 5	Purity of hydrogen gas	Improvised hydrogen gas generator (1) Test tube (2)	Zinc pieces, dilute Hydrochloric acid	Water, Match box
4 6	Reduction of Cupric oxide by hydrogen	Test tube (Hard glass) (1) Improvised hydrogen gas generator, Kerosene (1), Bent lamp tubing with a jet at the long end	Zinc pieces dilute Hydrochloric acid, Copper Oxide	-
4 7	Physical properties of acids (a) Hydrochloric acid (b) Sulphuric acid	(a) Test tube (4), Bent tubing 90° (1), glass rod (1), rubber stopper with a hole (1) (b) Test tubes (2), glass rod (1) beaker (1)	Marble chips, Hydrochloric acid, Litmus Paper, Lime water, Sulphuric acid, marble's piece	Water/Splinter
4 8	Action of acids on litmus solution	Test tubes (3), test tube stand (1), Dropper (1)	Hydrochloric acid, sulphuric acid, litmus solution	Water
4 9	Action of sulphuric acid on wooden splinters	Test tube (1), Test tube stand (1)	Litmus solution, Sulphuric acid	Wooden splinter
5 1	Heating of dry splinters, soil or blotting paper in a test tube (showing the presence of water in these)	Test tubes (3) Laboratory stand (1), Kerosene lamp (1)		Wooden splinter soil, blotting paper
5.2.	Distillation of water	R.B flask, laboratory stand, petrol gas generator of Kerosene lamp (1), Liebig's condenser (Improvised) rubber stopper with a hole (1), bent tubing 90° (1), Rubber tubing		Blotting paper, Coloured saline water
5.3.	Reaction between sodium and water	Pair of tongs (1) Filter paper (1), Boiling test tube (1), Watch glass (1), Laboratory stand (1), Rubber stopper with hole (1), glass tubing with a jet (1)	A piece of sodium metal	Splinter

5.4. Interaction between magnesium and steam	Boiling tube (1), Rubber stopper with a hole (1) bent tubing 90° (2) and 45° (1) Reaction tube (1) Burner (1), laboratory stand (2), Trough (1), Test tube (1), Rubber tubing (3), Kerosene lamp (1), Tripod (1)	Zinc powder	Water
5.5 Studying the solubility of common salt	Glass rod (1), Beaker (1), Balance and weight box, wire gauze (1)		Common salt water
5.6 Growing of a large crystal	Beaker (2), Stirrer (1), Kerosene lamp (1), Laboratory stand (1) Funnel	Copper Sulphate	Thread, Water, Cotton
5.7 Effect of temperature on solubility of Potassium Nitrate	Test tube (1), Beaker (1), Laboratory stand, Kerosene lamp	Potassium Nitrate	Water
5.8. Solubility of gases in water	Test tube (1), Beaker (1), Kerosene lamp (1), Laboratory stand (1)	—	Water
5.9 Dissolution of Sodium Hydroxide in water	Watch glass (1), Test tube (1), Glass rod (1), Test tube stand (1)	Sodium Hydroxide	Fresh cold water
5.10 Studying the action of an indicator on Sodium Hydroxide	Test tubes (2) Test tube stand (1) Dropper (1)	Litmus solution, Phenolphthalein	Water
5.11 Reaction of neutralization (a) simple method (b) by titration method	Test tubes (3), Polythene dropper (1), Beaker (1), Burette (1), Pipette (1) Glass rod (1) Laboratory stand (1) Test tube stand (1)	Sodium Hydroxide, Hydrochloric acid, Phenolphthalein	Water

PART II

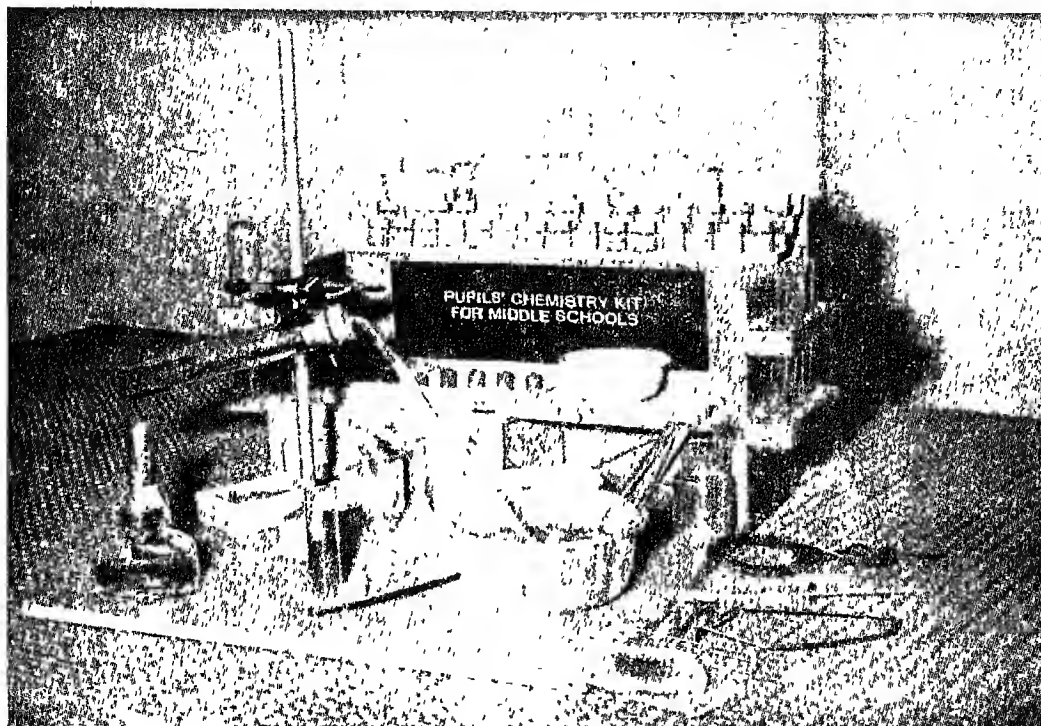
1.1 Interaction of basic oxides with acids	Test tube (1), Watch glass (1), porcelain dish (1)	Sodium Oxide, Calcium oxide, Magnesium Oxide, Phenolphthalein	—
1.2 Interaction between carbon dioxide and lime water	Funnel (1), Test tubes (2), Pinch cock (1) Rubber tubing (1), Glass tubing (1), Bent tube 90° (2) Laboratory stand (1)	Dilute Hydrochloric acid, Calcium Hydroxide, Marble chips	—
1.3 Reaction of combination of basic and acidic oxides	A loop of wire (1), China dish (1), Improved petrol gas generator (1)	Dilute Hydrochloric acid, CuO, SiO ₂ (sand) B ₂ C, CaO	Match box

1.4. Interaction of acidic oxides with bases	Round bottom flask (1), Funnel (1), Rubber tubing (1), Bent tube 90° (1), Pinch cock (1), Rubber stoppers (1), Kipp's Apparatus (Improvise) as a source for CO ₂	Dilute Hydrochloric acid, Marble chips, Caustic soda	
1.5. Interaction of acids with metals (Zinc and Sulphuric acid)	Test tube (2), Rubber Stopper (1), Jet tube (1), Watch glass (1), Wire gauze, Kerosene lamp (1), Laboratory stand (1)	Zinc pieces, Magnesium, Ribbon, Dilute Hydrochloric acid, Dilute Sulphuric acid	Match box
1.6. Interaction of acids with metals (Copper and Nitric acid)	Test tube (1), Watch glass (1), Wire gauze (1), Kerosene lamp (1), Laboratory stand (1) Test tube stand (1)	Copper turnings, Concentrated Nitric acid	Match box, splinter
1.7. Interaction of acids with bases (Hydrochloric acid and Copper Hydroxide)	Test tube (1), Test tube stand (1), Watch glass (1), Wire gauze (1), Kerosene lamp (1), Laboratory stand (1)	Dilute Hydrochloric acid, Copper Hydroxide (freshly prepared)	
1.8. Interaction of acids with salts (Sulphuric acid and Sodium Chloride)	Test tube (1), Test tube stand (1), glass rod (1), test tube holder (1), Kerosene lamp (1), Test tube stand (1)	Sodium chloride, (solid), concentrated Sulphuric acid, Ammonium Hydroxide solution	
1.9. Action of heat on Alkalis (Caustic Soda)	Spatula (1), Test tubes (2), Test tube holder (1), Kerosene lamp (1), Test tube stand (1)	Caustic Soda, Red Litmus solution	Water
1.10. Action of heat on insoluble bases (copper hydroxide and ferric hydroxide)	Test tubes (2), Test tube holder (1), Kerosene lamp (1), Test tube stand (1)	Copper Hydroxide Ferric Hydroxide (freshly prepared)	—
1.11. Interaction of salts with acids (Potassium Nitrate with Sulphuric acid)	Test tubes (2), Test tube stand (1), Kerosene lamp (1), Test tube holder (1)	Potassium Nitrate, Concentrated Sulphuric acid	—
2.1. Identification of Fertilizer (Potassium Chloride)	Graphite stick, Watch glass (1), Burner, Test tube stand (1) test tube	Concentrated Hydrochloric acid, Potassium chloride, Silver Nitrate Ammonium Hydroxide	Match box, water
2.2. Identification of the Fertilizer (Ammonium Nitrate)	Test tube (1), Test tube holder (1), Burner (1), test tube stand (1), test tube, pair of tongs blow pipe	Ammonium Nitrate, Sodium hydroxide, Red litmus paper	Piece of charcoal

3.1. Showing the presence of carbon in the following substances (a) wood chips (b) saw dust (c) sugar (d) cotton (e) wool	Test tube (6), Bent tube 90° (1), Rubber stopper with a hole (1), Laboratory stand (1), Burner, Rubber joints (2)	Calcium Hydroxide, lime water	Wood chips, Saw dust, Sugar, Cotton, Wool
3.2 Destructive distillation of wool	Boiling tubes (1), Rubber stopper with a hole (1), Bent tube with jet, Burner, China dish (1), Laboratory stand (1)	Blue litmus paper	Dry splinters, Match box
3.3 Absorbing property of charcoal	Round bottom flask (1), Rubber stopper (1), Laboratory stand (1), Kerosene lamp (1), Wire gauze (1)	Bromine drops	Charcoal pieces
3.4 Reduction of Copper Oxide by Carbon (charcoal)	Boiling test tube (1), Beaker (1), Laboratory stand (1), One holed rubber stopper (1), Kerosene lamp (1), Bent delivery glass tubing, Rubber tube	Copper Oxide, Lime water	Charcoal powder
3.5. Preparation of carbon monoxide	Improvised Kipp's apparatus (1), Improvised gasometer (1)	Sodium Formate, Sulphuric acid (Cone)	—
3.6 Reducing property of carbon monoxide	Improvised gas generator (1) or gasometer reaction tube (1), Kerosene lamp (1), Laboratory stand (2), Burner, Rubber stoppers (2), Glass tubing (1)	Sodium Formate, concentrated sulphuric acid, Copper Oxide	Charcoal powder
3.7 Preparation of Methane and its burning	Improvised gasometer (1), Boiling tube (1), Laboratory stand (1), Improvised gas burner (1), Rubber stopper with a hole (1), Bent tubing (90°, 45°), (1), Rubber tubing, glass tubing (1)	Sodium Acetate, Sodium Hydroxide, Calcium oxide	Match box
3.8. Distillation of crude oil	Round bottom flask (1), Test tubes (4), Laboratory stand (2), Thermometer (0-200 c), Rubber stopper with a hole (1), Liebig's condenser (Improvised) (1), China dish (1), bent tubing 90° (1), 100° (1)	Crude oil	

3.9 Study of the structure of flame	Improvised petrol gas generator (1), Narrow glass tube (1), Porcelain piece, blow pipe (1)	—	Candle stick, Match box
3.10. (a) Identification of starch	Test tube (3), Test tube holder (1), Beaker (1),	Starch powder, Iodine solution	Wheat, Bread, Potatoes
(b) showing its presence in other compounds	Tripod stand (1), Glass rod (1), Kerosene lamp (1), Test tube stand (1), Wire gauze (1)		
3.11 Properties of Proteins (egg)	Test tubes (3), Test tube holder (1), Test tube stand, Kerosene lamp (1)	Nitric acid concn	Cotton fibre, Woollen fibre, egg
4.1. Hardness of a metal (Sodium Metal)	Pair of tongs (1), Watch glass (1), Filter paper	Sodium Metal	Knife
4.2 Malleability of metals (Steel, zinc and lead)	—	Piece of steel, Piece of zinc, Piece of lead	Hammer, Block of iron
4.3 Interaction of zinc and water	Test tubes (2), Lab. stand (1), Rubber stopper with a hole (1), Bent tube 90° (2), 45° (1), Reaction tube Improvised (1), Burner, Kerosene lamp (1), Trough $\frac{1}{2}$ (1), Tripod stand	Zinc powder	Water, Wooden blocks (2)

CHEMISTRY PUPIL'S KIT FOR MIDDLE STAGE D S E. (C.S.W.) VIII



To provide adequate opportunity to the students to perform experiments in chemistry a special kit has been developed. Two students can work at a time. A tiny box 37 cm. x 14.5 cm. x 21 cm. height contains 37 different items, (several numbering more than one), 40 chemicals and 10 containers for solutions and acids. To complete the kit it has been suggested to arrange locally 31 miscellaneous items. Entire space available has been utilised to the maximum extent. A stepped container has been provided to keep 60 phials. This container can be fixed on the top of the box so that it does not make any hindrance to working. Just below these, two wooden boxes are

placed. These can also be taken out while performing the experiment.

This kit has also been designed keeping in view a village school which may not have any demonstration table. Thus the top front covers, hinged at the junctions at the top and bottom of the box, can be spread out on the ground or on improvised table to provide working space for the students. These two sides could be coated with epoxy paint which is acid proof in case cost is not the main consideration. On both sides of the box two test tube stands are provided for holding two boiling and eight test tubes. These stands also serve as handles for lifting the kit and carrying to places. Similarly a

burette has been fixed in the hollow space at the back of the stepped container to utilise all available space.

It is suggested that five such kits are provided by every school so that a batch of 10 students can perform experiments at a time. Thus a class of 30 students can be

split into three groups of 10 students each. All pupil's activities as listed in the textbooks can be covered. Chemicals and other consumable items will last for one year after which these have to be replenished. This is a very inexpensive kit so that it remains within the reach of every school.

LIST OF ITEMS

<i>Sr. No.</i>	<i>Name of the Item</i>	<i>Qty</i>
1. (a)	Iron rod	One
	(b) Base wooden block with a fixed nut in it	One
2.	Test tube stand for holding two bottles and eight test tubes (part of box)—serving as handles of the kit	Two
ITEMS PLACED IN BOX 'A'		
	(a) The lower part of the first compartment	
3.	Test Tube (neutral glass, 10 cm x 1.7 cm) good quality	Seven
4.	Test Tube (neutral glass, 10 cm. x 1.7 cm) good quality (with a hole at the bottom)	One
	(b) Upper portion of the first compartment (B box)	
5. (a)	Set of delivery tubes (corning quality, 6 mm. outer dia. 1.2 mm wall thickness)	
	(i) bent at 45° (3 cm. x 4 cm)	Two
	(ii) bent at 90° (3 cm. x 4 cm)	Three
	(iii) bent at 120° (3 cm x 4 cm.)	Two
	(iv) bent U type (each arm 2.5 cm. long)	Two
	(v) tube with a jet (5 cm. long)	Two
5. (b)	Glass tube with a jet (5 cm. long, outer dia, 8 mm)	One
6.	Rubber Stoppers	
	(i) No. 2	One
	(ii) No. 2 with a hole (6 mm.)	One
	(iii) No. 5 with a hole (17 mm.) (to allow test tube of item 4 to be fitted) To fit item 27	One
	(iv) No. 6 with two holes (6 mm.)	One
	(v) No. 6 with one hole (6 mm.)	One
7.	Rubber Tubing, Rubber Ring	
	(i) 7 cm. long (dia. 10 mm. outer)	One
	(ii) 2.5 cm long (dia. 8 mm. outer)	Six pieces
	(iii) Rubber disc 2 cm. dia. with a hole near the circumference	One
8.	Pinch Cock (screw type)	One
9.	Dropper (polythene) (good quality)	Two
	First compartment of the box	
10.	Beaker (neutral glass 50 ml.)	One
11.	Beaker (neutral glass 25 ml.)	One
12.	Polythene bottle (for indicator) (As per sample approx dia. 20 mm length 45 mm. 5 ml. capacity)	One
13.	Watch glass (5 cm. dia.) (neutral glass)	One

Second compartment of the box

14	Test tube (Corning, 15 cm. x 2 cm.)	One
15	Boiling tube (Corning, 15 cm x 2.5 cm.)	Two
16	Glass rod (with police-man) 5 mm (14 cm long) (placed in the long test tube)	To be placed inside One
17	Glass tubing (Corning) (14 cm long x 6 mm. outer dia.) same as 5 (a)	No. 14 Threc
18	Litmus paper (red and blue)	Two packets of each
19	Dropping bottles for chemicals (Amber colour about 15 ml. capacity fitted with rubber droppers)	Seven
20	Filter paper (placed below the box)	Half standard Sheet

Lower portion, on right hand of the kit, next to the box

21	Trough polythene (13 cm dia.) 65 mm.	One
22	Trough polythene (8.5 cm dia.) 35 mm.	One
23	Kerosene lamp with perforated chimney with wire tong	One
24	Evaporating enamel dish (7.5 cm. dia. flat type) (To fit inside No 22)	One
25	Funnel (5 cm dia. polythene)	One
26	Wash bottle 80 ml (40 mm dia.) 75 mm long with nozzle inside and screw cap made of polythene	One
27	Wide mouth bottle 50 ml (39 mm. dia 72 mm height, width of the mouth 30 mm. outer, made of glass) (To fit item 6 (iii))	One
28	Rubber tubing 15 cm. long (8 mm dia. outer)	One

ITEMS PLACED IN BOX 'C'

29	Test tube holder	One
30	Spatula (workshop design) plastic	One
31	Clamp holder	One
32	Ring clamp	One
33	Clamp extension	One
34	Deflagrating spoon (as per sample)	One
35	Test tube brush	One
36	Wire gauze (10 x 10 cm) with asbestos	One
37	Burette fixed under the gallery (25 ml.) (neutral glass)	One
38	Wooden Box (A)	One
39	Plastic Box (B)	One
40	Wooden Box (C) open from top 315 x 50 x 30 mm. height (outside) wall thickness 3 mm.	One
41	The kit box	

LIST OF CHEMICALS

I ROW

17 ml (glass)

1. Ca(OH)_2
2. CaO
3. NaOH
4. NaNO_3
5. NH_4NO_3
6. $\text{Pb(NO}_3)_2$
7. FeSO_4
8. FeCl_3

9. $\text{Zn(NO}_3)_2$ 10. $\text{Cu(NO}_3)_2$

11. Iodine crystals

12. KMnO_4 13. KNO_3 14. $\text{Ba(NO}_3)_2$ 15. BaCl_2

II ROW

13 ml. (polythene)

1. CaCl_2

- 2 CuCO_3 (basic)
3. —do—
- 4 NaCl
5. —do—
6. CaCO_3 (marble chips)
7. —do—
- 8 Zn pieces
9. —do—
10. CuSO_4
11. —do—
12. Sugar
13. Sulphur
- 14 CuCl_2

III ROW

7. *ml*
- 1 Starch
- 2 —do—
- 3 CuO
- 4 —do—
- 5 MgO
6. Na_2CO_3
7. —do—

- 8 Fe_2O_3 or Fe_3O_4
- 9 Kcl
10. —do—
11. CaCO_3 (salt)
- 12 Na_2SO_4
13. —do—

IV ROW

- 7 *ml*
1. NaHCO_3
2. AgNO_3
3. K_2SO_4
- 4 PbO
5. P (red)
6. Cu (turning)
7. Fe (powder)
- 8 Mg (ribbon)
- 9 C (Charcoal powder)
- 10 Cu (wire)
11. Fe (wire)
- 12 Al (wire)
13. Glycerine
14. Litmus (powder)
- 15 Methyl orange.

Acids Bases placed in the 1st compartment of the Box.

1. HCl
2. H_2SO_4
3. HNO_3
4. H_3PO_4
5. CH_3COOH
6. NH_4OH
7. NaOH

To be provided in the kit

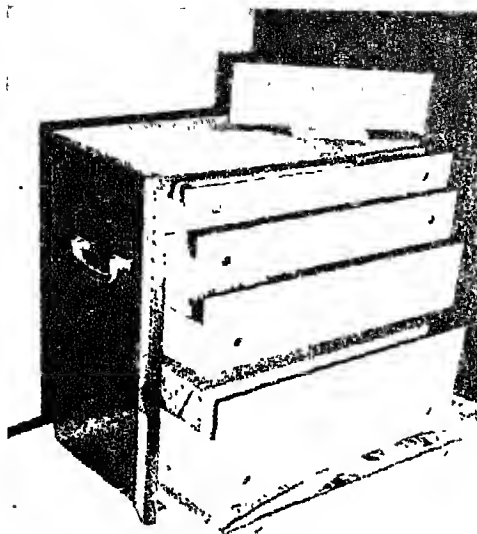
Copper plate
Iron plate
Aluminum plate
Lead plate
Zinc plate
Splinters of wood.

To be arranged locally

1. Graphite stick or Platinum wire

2. Plastic
3. Sand
4. Kerosene oil
5. Mustard oil
6. Vaseline
7. Scent
8. Vinegar
9. Spirit
10. Petrol
11. Naphthalene
12. Chalk powder
13. Iron nails
14. Groundnut seed
15. Boiled egg
16. Knife
17. Sand paper
18. Wool

PHYSICS DEMONSTRATION KIT III C S W. IX



This kit completes the series of Physics Kits for middle school and is meant for the final year class. Apparatus has been improvised in subject areas of light, magnetism and electricity. This is contained in a wooden box measuring 530 mm. \times 290 mm. \times 620 mm. height. There are 74 items including the kit box. The top of this box may be utilised as the demonstration table in village schools where separate tables are not available. This box, when not in use, may be kept in the corner of a room and so it eliminates storage problems.

A special smoke chamber has been developed for experiments on light. The source of light will be the natural sunlight which is available in India round the year. Openings for admitting sun rays have been provided on both sides so that the box may be used

in the same position either in morning or after noon hours. The device enables vision of rays in various phenomena so that students can actually see the diversion of rays through different media. It replaces the paper and pin exercise and leaves an ever lasting impression on the young mind.

Keeping in view a village school where electricity may not be available, the apparatus for magnetism and electricity is so designed that it operates on the combination of three dry cells which have been provided in a container in the Kit. The models are simple, effective and inexpensive. The size of each of the items is big enough to be observed by the entire class. A kit guide has been provided which explains the use of various items.

Reference Book Published (NCERT)

- (a) Text Book—
Physics Part III—Science for Middle School
(revised)
- (b) Teacher's Guide for Physics Part III
- (c) Kit Guide

Scientific Topics covered under the New Curriculum

1. Light
2. Electric charges and electric field
3. Electric current
4. Potential difference in resistance
5. Electromagnetism
6. Electric energy and Power
7. Structure of atom and atomic energy

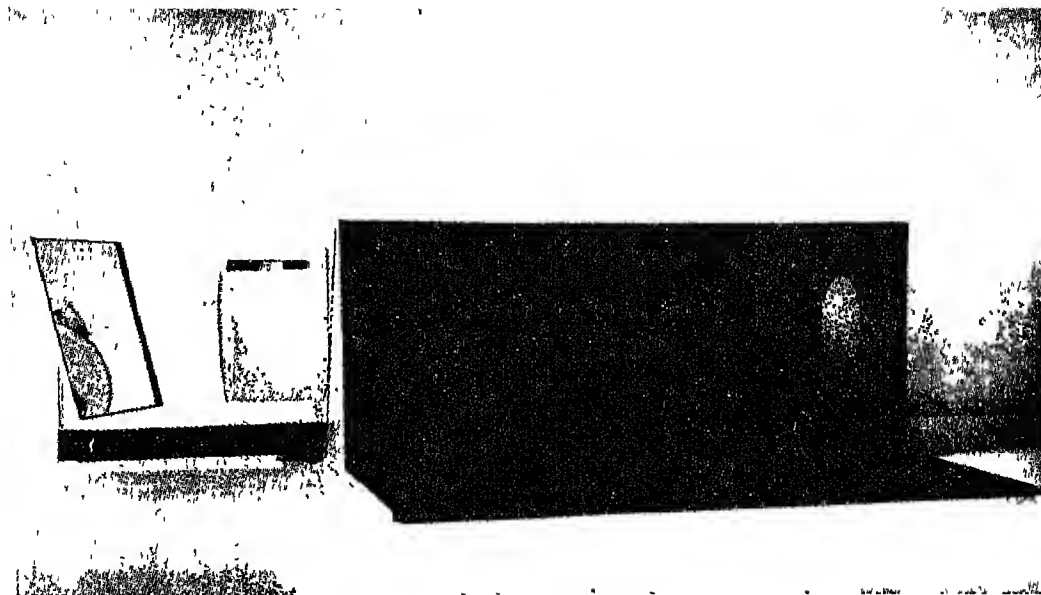
LIST OF ITEMS

<i>S. No.</i>	<i>Chapter</i>	<i>Item</i>
P.D. 301.	General	Laboratory stand with clamp and boss-head
302.	-do-	Paper clips (1 doz.)
303.	-do-	Screw Driver (100 mm) (good quality)
304.	-do-	Cello tape (12 mm.)
305.	-do-	Dry cells (3)
306.	-do-	Container box for 3 Dry cells (polythene)
307.	-do-	Electric-connector (with plastic board and crocodile clips)
308.	-do-	Set of connecting wires (6 pairs) 4-50 cm and 8-35 cm.
309.	-do-	Bar Magnets (pair) (good quality)
310.	Chapter I	Smoke box
311.	-do-	Disc holder
312.	-do-	Adjustable plane mirror on stand
313.	-do-	Holder with two convex lenses (for producing point source)
314.	-do-	Cover with slits
315.	-do-	Cover with 'F' slit
316.	-do-	Cover without slit
317.	-do-	Metallic container for smoke source
318.	-do-	Periscope
319.	-do-	Plane mirror (small)
320.	-do-	Glass slab rectangle shape
321.	-do-	Glass slab 'D' shape
322.	-do-	Prism
323.	-do-	Convex lens
324.	-do-	Concave lens
325.	-do-	Concave and convex mirrors
326.	-do-	Screen with hook
327.	-do-	Pinhole camera
328.	-do-	Stand for lens
329.	-do-	Screen
330.	-do-	Photometer
331.	-do-	Screen with rectangle cut
332.	-do-	Plastic ball (small)
333.	-do-	Plastic ball (big)
334.	Chapter II	Electrophorous (20 cm dia)
335.	-do-	Plastic strip with positive charge
336.	-do-	Plastic strip with negative charge
337.	-do-	Piece of Silk (pure) (20 cm. \times 20 cm.)
338.	-do-	Piece of woollen cloth (20 cm \times 20 cm.)
339.	-do-	Plastic strip with a piece of woollen cloth
340.	-do-	Electroscopes (pair)

341.	Chapter II	Probe steel ball on insulating handle
342.	-do-	Al Foil leaves on silk thread in container.
343.	-do-	Insulated stands (pan)
344.	-do-	Straight conductor with insulated handle
345.	-do-	Suspension for plastic strip
346.	Chapter III and IV	Glass tumbler-60-70 mm dia.
347.	-do-	Neon bulb (small)
348.	-do-	Zinc plate
349.	-do-	Copper plate
350.	-do-	Torch bulbs (2.5 V) -3 in container
351.	-do-	Ammeter
352.	-do-	Voltmeter
353.	-do-	Board with wires of different resistance
354.	-do-	Carbon electrodes (2)
355.	-do-	Copper sulphate in plastic container (50 ml.)
356.	-do-	Holders for torch bulbs (3.)
357.	-do-	Set of resistors, (5,10,10,20,) Ohm.
358.	-do-	Rheostat, 50 Ohm
359.	-do-	Electromagnet with iron core
360.	-do-	Spring for the core
361.	Chapter V	Electric motor-cum-generator model
362.	-do-	Wooden block
363.	-do-	Heating effect of current model
364.	-do-	Model of electric fuse holder
365.	-do-	Fuses (50 Pcs in container)
366.	Chapter VI	Iron dust in plastic container (20 gm)
367.	-do-	Compass model
368.	-do-	Magnetic needle (pair)
369.	-do-	Device for magnetic field of straight conductor
370.	-do-	Magnetic field of solenoid apparatus
371.	-do-	Electric bell-cum-telegraph model
372.	-do-	Device for motion of conductor in magnetic field
373.	-do-	Wire loop in a magnetic field
374.	-do-	Kit box

Examples of Improvisation

32. SMOKE BOX (*S. No. 310*)



Requirements

- (i) A device to perform experiments on light and optics.
- (ii) To operate on the rays of the Sun.
- (iii) The size of the device to be enough for observation of experiments and suit the kit box.
- (iv) Visibility of various phenomena.
- (v) Easy operation.
- (vi) To be sturdy.
- (vii) To be inexpensive.

Availability in the market

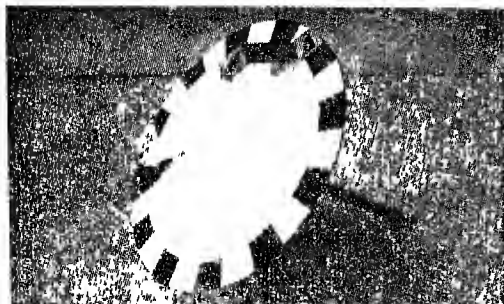
Such device is not available but instead the experiments are usually performed with the help of paper and pins.

Some devices are available but are very

costly and also use other source of light which is not available in villages.

The Prototype

Wooden box of size 470 x 180 x 195 mm. height with round openings covered with glass on two sides to admit rays of light inside, has been designed which operates on Sun rays and provides visibility of the path of light with the help of smoke inside. This size permits its being kept inside the kit box. Lenses are mounted on a scale inside and also on the lid of the whole admitting Sun rays. There is a small device for keeping incense for making smoke. Intensity of smoke could be adjusted by moving out this device. Operation is simple and the device is sturdy and inexpensive.

33—DISC HOLDER (*S. No. 311*)**Requirements**

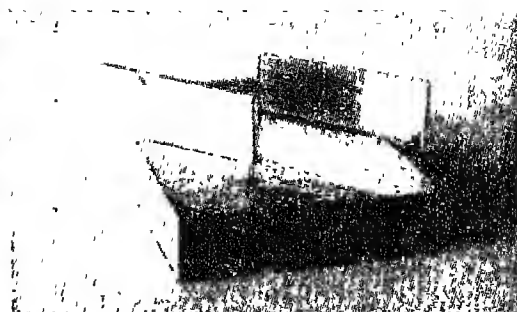
- (i) A device to mount glass prisms, rectangular slab, D-shaped slabs periscope, concave and convex mirrors inside the smoke box.
- (ii) Easy replacements of these items mentioned above.
- (iii) No obstruction to light in the above mentioned items while doing experiments.
- (iv) Should rotate and be kept in any position.
- (v) Angular graduations on the disc to show divergence of rays.
- (vi) It should be easy to handle, sturdy and inexpensive.

Availability in the market

Since this forms a part of accessories of smoke box, these are not available in the market.

The Prototype

The prototype satisfies the requirements. A circular disc with painted thick angular graduations illustrates the divergence of rays. This disc mounted on a rod can be rotated and kept in any position. The fixtures for holding the various optical items have been designed not to obstruct the path of light rays. It is strong, easy to handle and inexpensive.

34—PERISCOPE (*S. No. 318*)**Requirements**

- (i) A device to illustrate the principle of periscope.
- (ii) An open model to provide visibility of the phenomena.
- (iii) An appropriate size to be held on the disc holder of the smoke box.
- (iv) Simple, sturdy and inexpensive.

Concept

Reflection of light.

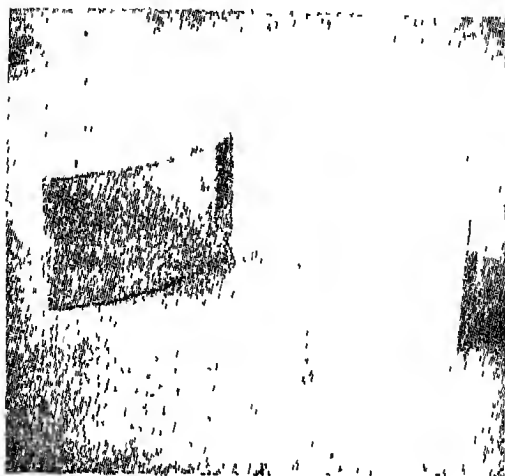
Availability

No such model available in the market.

The Prototype

The prototype satisfies all the requirements. Two small mirrors mounted on a wooden block of normal thickness of an optical slab illustrate the phenomena of reflection of light as is used in a periscope. The block is then mounted on the disc holder of the smoke box. Since the disc holder can rotate and be kept in any position, the light rays can be reflected in any number of angular positions. The device is sturdy, easy to handle and inexpensive.

35—CONCAVE AND CONVEX MIRRORS (S. No. 325)



Requirements

- (i) Convex and concave mirrors to be mounted on the disc holder of the smoke box.
- (ii) Unbreakable or lasting.
- (iii) Simple, sturdy and inexpensive.

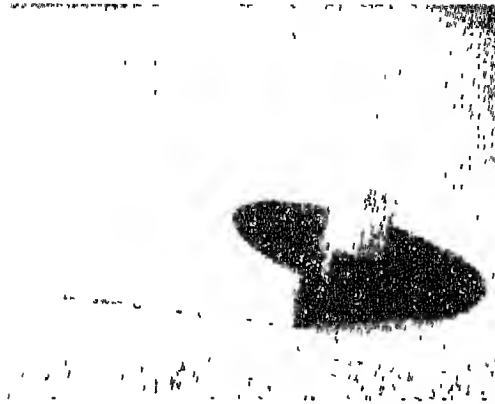
Availability

Conventional convex and concave glass mirrors available which are breakable and cannot be mounted on the disc holder.

The Prototype

The mirrors are made out of aluminium sheet of 2 mm. thickness and buffed to give them proper shine. These are unbreakable. These have been fixed on plastic pieces of thickness equal to the thickness of the glass slab, so that these can be mounted on the disc holder of the smoke box. The curvature of concave mirror is such that the focal point can be seen on the surface of the disc. It is sturdy, simple and inexpensive prototype.

36—ELECTROPHOROUS (S. No. 334)

**Requirements**

- (i) A device to produce the static electricity charge.
- (ii) It should not be dangerous to human body.
- (iii) The discharging spark should be visible.
- (iv) Easy to handle, inexpensive and durable.

Availability

Conventional apparatus available which is very expensive.

The Prototype

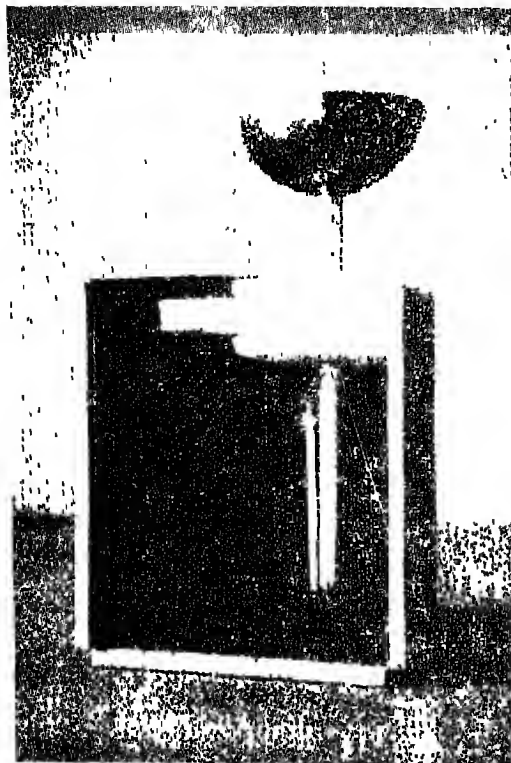
The prototype consists of a circular, painted M.S. sheet of diameter 200 mm. This disc has a handle in the centre which is covered by fixing thermocole rectangular

block. There is a thermocole board of size 200 mm. \times 200 mm. \times 25 mm. height. A piece of woollen cloth is also provided.

The static charge is produced by rubbing the woollen piece on the thermocole board. It is transferred to the M S disc when it is placed on this board and just touched with finger, which should immediately be removed. The disc is then lifted. The charge gets accumulated on the disc. When the finger is then brought near the surface of the disc slowly, a spark can be seen and its crackle heard. The spark is not dangerous but the intensity will depend upon the intensity of rubbing.

This is a very simple device and cuts the cost to a meagre amount as compared with conventional apparatus. It is sturdy and durable.

37. ELECTROSCOPES (PAIR) (S No. 340)

**Requirements**

- (i) A device for transferring charges from charged body to uncharged body.
- (ii) Also to indicate intensity of charge transferred.
- (iii) The indicator of charge to be visible to teacher as well as to pupils.
- (iv) To be highly sensitive.
- (v) To indicate two different types of charges transferred through induction.

- (vi) It should be easy to handle, inexpensive and durable.

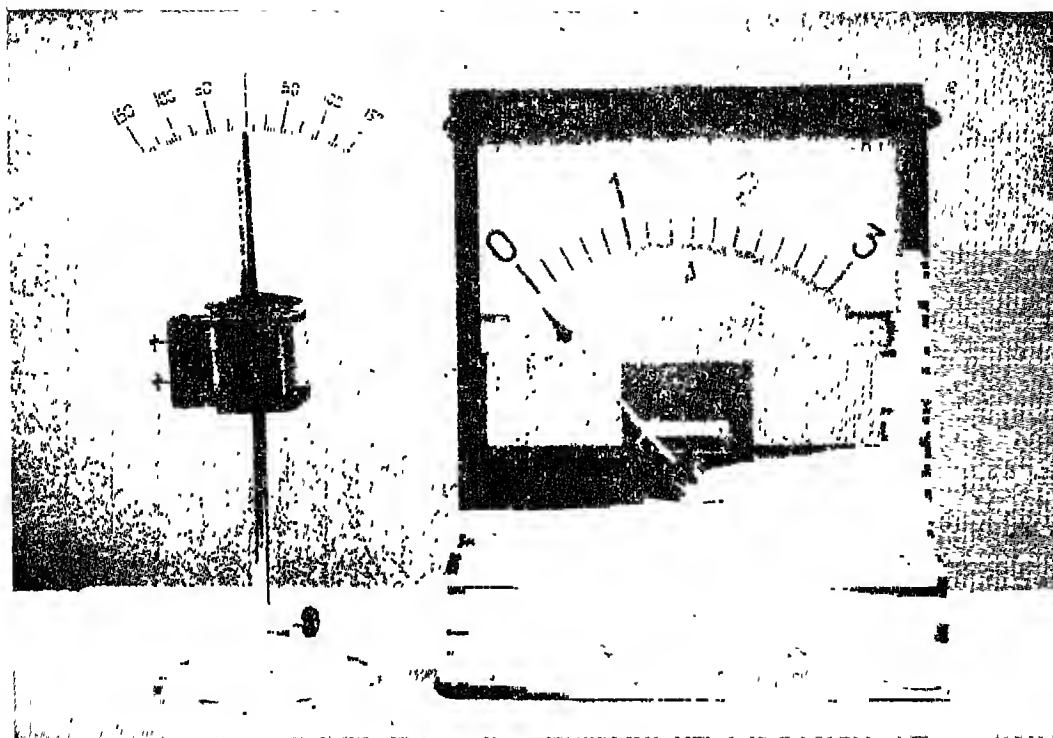
Availability

Conventional type of models available but expensive.

The Prototype

The prototype satisfies the requirements. It is sensitive and deflection of indicator can be easily watched by students at a distance of 6 metres. A window has been provided at the back so that the teacher can watch the indicator at the same time without obstructing the view of the students. This is located at the top of the back screen whose remaining part is painted with dark colour. Since the pointer is made out of the aluminium foil, this background gives a contrast and the movement of the pointer can be noticed easily. The insulation is made of the thermocol which is a perfect insulator for static electricity and is inexpensive. A cup-shaped bowl is provided at the top to increase the surface area receiving the charge. If two such electroscopes are connected by a wire at the bowls, different types of charges can be induced in each of the electroscopes when a charged body is brought near one of them or touches one. The probe metallic ball is used for transferring charge from one electro-scope to another. It is a simple device, inexpensive and durable.

38. AMMETER (S. No. 351)

**Requirements**

- (i) A device to measure current from dry battery cells.
- (ii) To be an open model to demonstrate the principle of its working.
- (iii) To be sensitive to verify Ohm's Law
- (iv) Detachable to show the construction.
- (v) Easy to handle, inexpensive and durable.

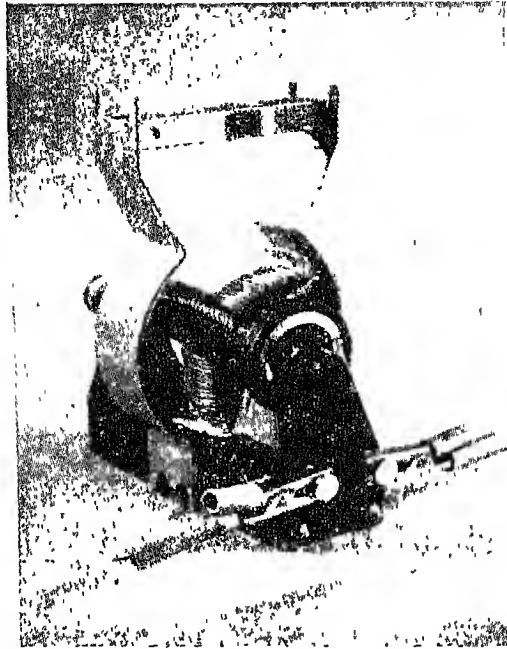
Availability

Conventional type closed model is avail-

able. It is expensive and also does not fulfil above requirements.

The Prototype

The prototype consists of a plastic base, support for permanent ring magnet and the plastic pointer, made out of brass and the detachable coil with aluminium wire. This is quite sensitive and can be operated even on a single dry battery cell. With the help of a similar voltmeter, Ohm's Law can be verified. A scale is provided with divisions for reading the current. It is easy to handle, inexpensive and durable.

39. MODEL OF ELECTRIC MOTOR-CUM-GENERATOR (*S No. 361*)**Requirements**

- (i) A device to show the principle of working of the electric motor and of generator.
- (ii) To be an open model to demonstrate its working.
- (iii) To operate on dry battery cells
- (iv) Easy to start with battery cells without any other efforts.
- (v) Use of permanent magnets or electro-magnets can be demonstrated.
- (vi) Easy to handle, inexpensive and sturdy.

Availability

Such models are not available.

The Prototype

The prototype satisfies the requirements.

Its plastic base supports 3 pole armature mounted on a shaft. On its sides are fixed two iron strips of a particular shape which substitute for the casing. On the top of these strips either permanent magnet or a core with coil can be held. The armature is wound with aluminium wire to reduce the cost.

To work the model as a generator, a piece of string is wound on the pulley fixed on one side of the shaft (the terminals are connected with ammeter or voltmeter) and then the string is pulled with a jerk. The deflection of pointer will indicate the generation of the current.

The prototype is very simple and can be fixed on the laboratory stand. It is inexpensive and durable.

40. HEATING EFFECT OF CURRENT MODEL (BATTERY OPERATED) (S. No 363)



Requirements

- (i) A device to make heating effect of current visible and to show burning of paper.
- (ii) To operate on dry battery cells.
- (iii) To be visible from a distance of 6 metres.
- (iv) Protected from wind
- (v) Simple, inexpensive and durable.

Availability

No such device, fulfilling the above requirements available

The Prototype

It satisfies the requirements. Coiled nichrome wire is fixed on the two copper wire supports. Each of these supports has a terminal at its end. This is placed in a plastic container with lid. It can be operated by three cells. The nichrome wire is heated and it glows. It is taken out and piece of paper can be burnt. Spare nichrome wires have been provided for replacement, if required. It is easy to handle, inexpensive and will last long if used with care.

41. MODEL OF ELECTRIC FUSE HOLDER WITH FUSE (BATTERY OPERATED)
(S No 364 and 365)



Requirements

- (i) A device to demonstrate the use of fuse in a circuit
- (ii) To operate on dry battery cells.
- (iii) Easy replacement of fuse
- (iv) Visibility of action taking place.
- (v) Easy to handle, inexpensive and sturdy

Availability

No such device operating on battery cells available.

The Prototype

It consists of a plastic holder on which

are fixed two crocodile clips. The fuse wire is fixed on a small piece which can be held between the two crocodile clips. The frame has two terminals which are connected to each of the crocodile clips. When the terminals which are connected to a battery cell operated circuit, the fuse will blow in case it is short circuited. At the time of blowing, the paper fixed to the fuse wire will start burning. When the paper stops burning, it is an indication that the fuse has blown off. Paper is attached to the fuse wire to prolong the demonstration, otherwise the fuse will burn instantaneously and the pupil will fail to observe the phenomena.

42. DEVICE FOR MAGNETIC FIELD OF STRAIGHT CONDUCTOR (*S No 369*)**Requirements**

- (i) A device to demonstrate the magnetic field created by a straight conductor.
- (ii) To operate on dry battery cells.
- (iii) To be easy to handle, inexpensive and sturdy.

Availability

Such model is not available.

The Prototype

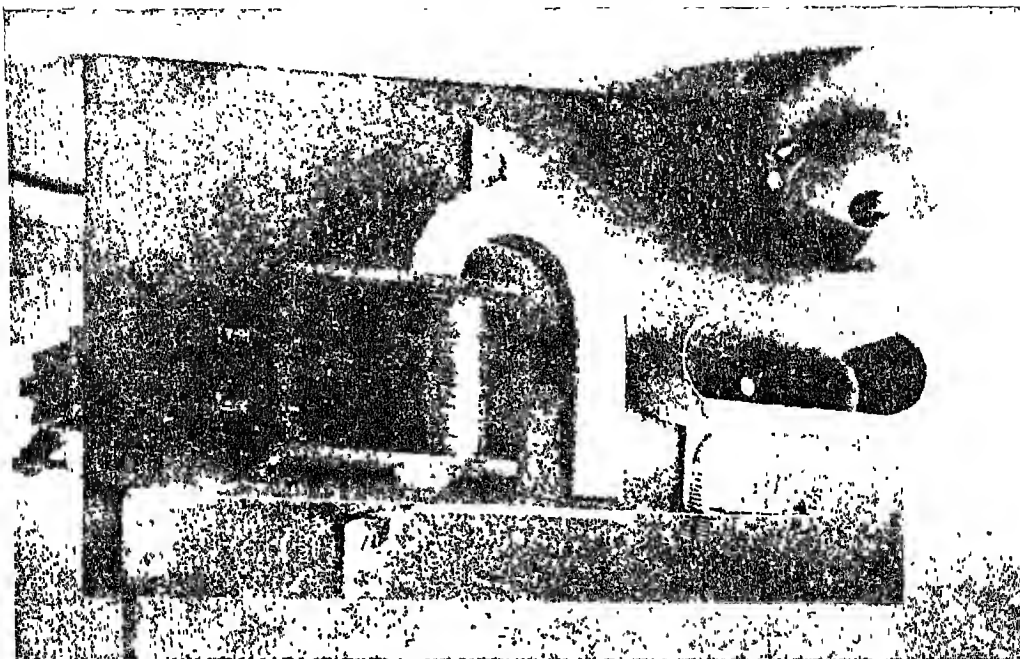
The prototype consists of two painted aluminium bases fixed at right angles. An aluminium coil properly insulated is wrapped round the bases to serve as the straight conductor. Since one single conductor operated on battery would have produced very weak magnetic field, we have provided

a number of straight conductors which represent the coil. The front part of the coil will look like a straight conductor and the portion at the back will be concealed behind the vertical base.

The device is fixed on a laboratory stand by holding either the back portion of the coil or the lower portion of the vertical base by a clamp. The iron dust is then spread out equally round the straight conductor on the horizontal base. The two terminals of the device are then connected to the dry battery cell holder. To get a clear picture of the magnetic field the horizontal plane is gently tapped for 5-10 seconds by a pencil or even with a finger.

The prototype satisfies the requirements. It is easy to handle, inexpensive and durable.

43. ELECTRIC BELL-CUM-TELEGRAPH MODEL (S. No. 371)

**Requirements**

- (i) A device to show the principle of electric bell and telegraph apparatus.
- (ii) To operate on dry battery cells.
- (iii) Visibility of action.
- (iv) Easy conversion of electric bell into the telegraph apparatus and *vice-versa*.
- (v) Simple in operation, inexpensive and durable.

Availability

Models available are not convertible.

The Prototype

The device fixed on a wooden board has a coil mounted on a U-shaped iron core. This coil is also used in other items to cut the cost. The bell or telegraph apparatus can

be fixed to the wooden board easily. A spring steel strip carrying a mild steel plate and a striker at the free end is fixed on the other end. There is a gap between the tips of the U-shaped iron core and the strip which is adjustable by means of a screw type terminal.

For showing the bell action, the circuit is completed by connecting one end of the battery holder to one terminal of the coil. The other terminal of the coil is connected to the screw type terminal which should touch the strip. The other end of the battery holder is then connected to the strip. The action will then start.

To convert it into the telegraph apparatus, only the bell cap is replaced by the support for paper strip. A device for making impressions in ink on the paper tape is also

fixed. The circuit in this case is completed by connecting one terminal of the coil to the battery holder and other terminal of the coil is connected and disconnected by the teacher to the other end of the battery holder. At the same time the paper tape is moved by the student. This will reproduce the telegraph code on the paper.

44. DEVICE FOR MOTION OF CONDUCTOR IN
A MAGNETIC FIELD (S. No. 372).

Requirements

- (i) A device to demonstrate the motion of conductor in magnetic field.
- (ii) To operate on dry battery cells.
- (iii) Easy to handle, inexpensive and durable.

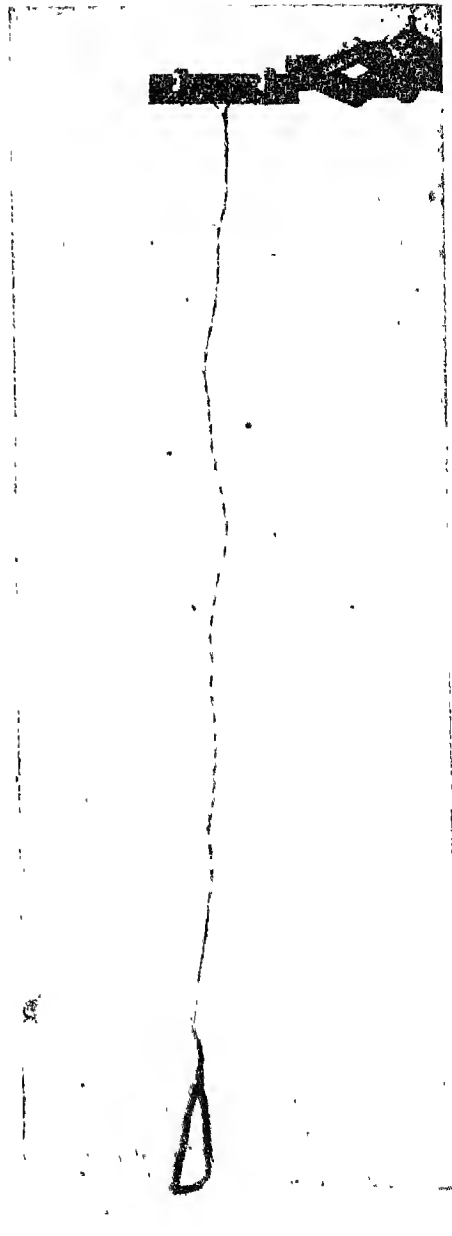
Availability

No such model available.

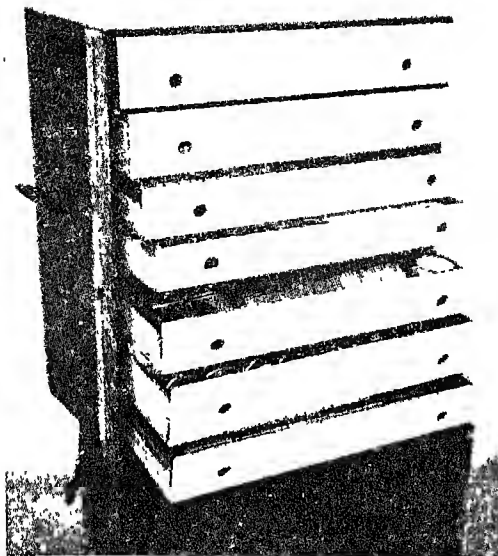
The Prototype

Since a single conductor will produce a weak magnetic field in a dry cell battery operated circuit, a number of copper conductors have been provided in the triangular shaped coil. The lower portion will serve as a conductor. The coil is connected with two half metre long flexible wires connected to the terminals on the hard board base at the top. The base is fixed on the laboratory clamp. The coil is suspended in between two magnets.

When the terminals are connected to the dry battery cell holder, the motion of the conductor is observed. If the poles of a magnet or the direction of the current are changed, the motion will be observed in the opposite direction.



PHYSICS PUPIL'S KIT NO. III
D.S.E. (C.S.W X)



This Kit has been designed as a supplement to the Physics Demonstration Kit No. III. It contains sufficient material to enable a class of 45 students to perform their own experiments in batches of three each.

A special kit box made of wood contains seven drawers. Fifteen sets of 39 items in varying quantities are kept in the drawers. The box measures 480 mm. \times 257 mm. \times 630 mm. height. There is no problem of storage as this kit may be kept in a corner of a room. These items have been listed tray-wise so that the students can themselves re-

place these items after performing experiments.

Although most of the items correspond to those of the Physics Demonstration Kit No. III, a few are really the simplified models or pupil's version. This cuts the cost and the handling becomes easier. Two such examples of improvisation are given in the following pages.

A list of items has been given. It may be seen that a number of these are available in the market.

LIST OF ITEMS

<i>Sr No</i>	<i>Name of the item</i>	<i>Qty</i>
TRAY NO. 1		
1.	Holder for the cells	1x15
2.	Dry cells	3x15
3.	Support for the glass sheet	1x15
TRAY NO. 2		
4.	Improvised photometer	1x15
5.	Glass sheet, square, 100 mm. x 100 mm. x 3 mm.	1x15
6.	Convex lens mounted on a stand 80 mm focal length, 40 mm. diameter	1x15
7.	Screen, out of tin sheet, supported, 100 x 100 mm. painted white	1x15
8.	Plastic strip chargeable negatively with a small hole in the middle above the centre	1x15
9.	Similar chargeable positively, 100 x 25 x 25 mm.	1x15
10.	Similar, with a piece of cloth attached	1x15
11.	Piece of cloth for rubbing 50 x 100 mm.	1x15
12.	Light foil strip on a silk thread	1x15
13.	Silk thread	One roll
14.	Support for Photometer	1 x 15
TRAY NO 3		
15.	Plane mirror, 30 x 80 mm on a wooden slab 30 x 80 x 20 mm.	1x15
16.	Glass Slab, 40 x 60 x 15 mm.	1x15
17.	Simple electroscope (mounted in a glass bottle)	1x15
18.	Carbon electrodes with holder	2x15
19.	Plastic tumbler	1x15
TRAY NO 4		
20.	Candles small size 100 mm.	2x15
21.	Torch bulb on a support, 2.5 V, 45 mm height	1x15
22.	Copper sulphate	1 packet (250 gms)
23.	Permanent bar magnets	1 pair x 15
24.	Iron dust in a container	1 container x 15
25.	Magnetic needles, 40-50 mm length	2x15
26.	Support for magnetic needle	2x15
27.	Coil, 220 turns, 40 mm. length, 5 mm. inner dia.	2x15
28.	Iron core for the above coils, 70 mm. length	1x15
TRAY NO. 5		
29.	Paper pins, steel, 30 mm. long	1 packet
30.	Connecting wires	6x15
31.	Heating wire in a holder	1x15
TRAY NO. 6		
32.	Ammeter, simplified model	1x15
33.	Connector (improvised key)	1x15
34.	Resistors, 5 Ohm and 10 Ohm	1 set x 15
TRAY NO. 7		
35.	Scale, (students) aluminium, 30 cm length	1x15
36.	Protractor, (students)	1x15
37.	Hardboard sheet, 20 x 230 mm	1x15
38.	Piece of high resistance wire (200 mm. length)	1x15
39.	Cello tape	One roll
40.	Kit Box	1

Examples of Improvisation

45. SIMPLE ELECTROSCOPE (PUPIL'S)



Requirements

- (i) A device to indicate different charges.
- (ii) Size to be small.
- (iii) To be sensitive.
- (iv) Inexpensive.
- (v) To be easy to handle and sturdy.

Availability

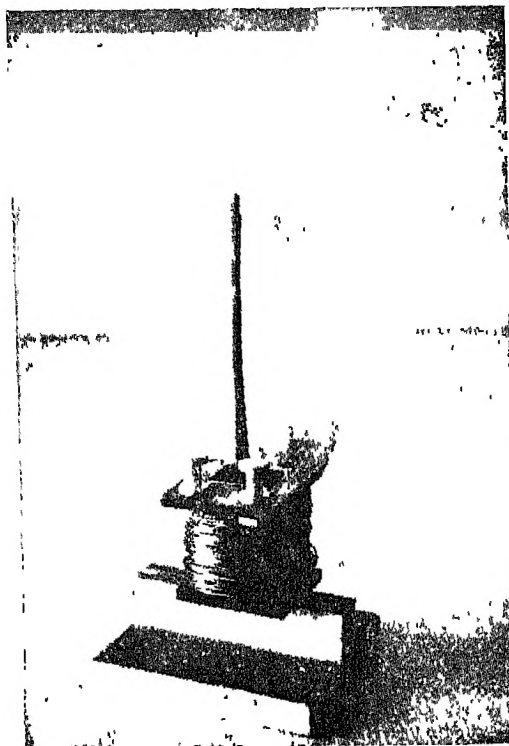
No such device available.

The Prototype

It consists of a small cylindrical glass container and a thermocol cork with a steel rod having aluminium foil fixed to it with a

cotton thread. The cork is fitted to the glass container. Positive and negative charges can be induced to the aluminum foil by bringing a charged body near the top end of the steel rod or by touching. The aluminium foil will repel and indicate the presence of the charge. The intensity of repulsion will depend upon the intensity of the charge. In this state, if the opposite charge is brought near the top end of the steel rod or touched, the aluminium foil will return to its original position. The cost is almost negligible and the device is sensitive and sturdy.

46. AMMETER (PUPIL'S)

**Requirements**

- (i) A device to measure current in pupil's experiment.
- (ii) To operate on dry battery cells
- (iii) To be sensitive.
- (iv) Easy to handle, inexpensive and sturdy.

Availability

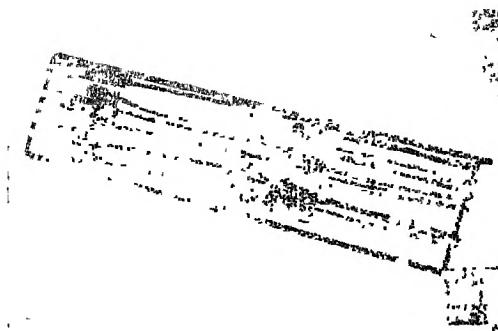
No such device available.

The Prototype

The prototype consists of a wooden base (which is used in optics experiments also) and a U-shaped brass support for a detachable coil and a plastic needle mounted on ring magnet. The coil is then connected in an electrical circuit. The plastic needle will immediately deflect. More the current, more the deflection. A scale is provided with divisions for reading the current.

The device is simple, inexpensive and sturdy.

47 FRAME FOR KEEPING CONNECTING WIRES

**Requirements**

- (i) A device to store six connecting wires.
- (ii) Convenient to handle in taking out wires and placing them back.
- (iii) Simple, inexpensive and durable.

The Prototype

A frame is made out of M.S. wire 3 mm. thick. One end of the connecting wires with crocodile clips can be fixed on one side of the frame. The wire is then wrapped round the other side and fixed in middle of the frame. It is convenient to handle and can be stored in the kit box easily. It is inexpensive and durable.

7. Scope for Further Improvements

THERE was age-old belief that science could be taught only by means of sophisticated apparatus. Lack of this apparatus and the cost involved proved to be a deterrent in introducing science in all the stages of school education. Further, it was felt that for a proper approach to science teaching there should be separate laboratory in each school. This was beyond the reach of the village schools where even the optimum space for classes is not available and due to the large number of such schools, the State Governments also find it difficult to provide additional facilities. Moreover, handling of the conventional apparatus required scientific background of the teacher. In a primary school, teachers are generally without such background and even in middle school, they are not adequately oriented. To replace such a huge number of teachers or to provide additional science teachers in every school could not be considered feasible.

These prototypes thus fill a vacuum and motivate educational planners and administrators to introduce science teaching at school level. The apparatus is inexpensive and has been designed keeping in view the limitations of a remote single teacher village

school. It is simple and its use is fully explained so that teacher/pupil can use with confidence. Parts are easily replaceable and the operation of items is not dependent upon the availability of gas, electricity or tap water. Lot of efforts have gone into the production of teacher guides and textbooks to enable even a non-science teacher to explain various phenomena to the students.

These prototypes, therefore, fulfil a great need and have brought a revolution in science teaching at school level. The process of development and improvement is continuous and we do not claim our prototypes to be perfect. Even in our workshop, the final prototype was different from the first one. Efforts are still being made to use better material, evolve simpler designs and at the same time cut down the cost.

We hope that the institutions already involved in research, developments and production of scientific apparatus will give us the benefit of their experience in improvement of the designs of these prototypes. At the same time, we have no objection to the private manufacturers taking up mass-production of these kits, provided the quality and price are maintained at proper level.

